RAILROAD GAZETTE

FRIDAY, DECEMBER 29, 1876.

Hydraulic Riveting Machines.

The following is an article contributed to the *Journal of the Franklin Institute* by Wm. Sellers & Co., who are the manufacturers of the Tweddell riveter in America:

In the earliest form of riveting machine, the riveting die was actuated either by a crank or a cam, so that the traverse of the die was uniform, and determined by this driving mechanism. The rivet, whether large or small, long or short, was compressed to the same length, often in rivet holes of varying diameters. Sometimes, therefore, the rivet did not fill the hole; sometimes the plates to be riveted were strained. The work was performed by gradual compression, in itself desirable, but the uniform traverse, operating upon irregular quantities in the rivet, and even forcing the metal into holes of varying capacity, failed to produce regular work.

The direct-action steam-riveting machine produces regular work with irregular quantities in the rivet or varying size of the holes; but inasmuch as the work is done by a blow, the shock is, in time, destructive to the machine, and sometimes is injurious to the work.

Hydraulic riveting was first accomplished by a machine on which hydraulic pressure was employed to act directly upon a compressing piston, which carried the riveting die; but in all these hydraulic machines, a pump was employed to produce the pressure in the compressing cylinder, which cylinder was in communication with the pump chamber through a valve which was opened by the fluid whenever the pressure in the pump exceeded that in the cylinder; consequently the compressing piston, which carried the die, was moved only when the pump moved to force the fluid through the valve, and rested when the pump was taking water for its next stroke. Hence the die might be stationary, while a rivet was but partially headed. Moreover, the compressing piston and die did not move at the will of the operator, but with the motion of the pump, whether it was worked by hand or power. If by hand, the workman had no means of controlling the pressure but by his judgment or strength; if by power, a valve to release the pressure was provided, which could be opened by the operator whenever, in his judgment, a sufficient pressure had been exerted; but no means of determining this with any degreee of accuracy was provided in either case, so that, although the pressure was gradual, and the traverse limited only by the performance of the work, the want of means to determine the latter produced irregular results.

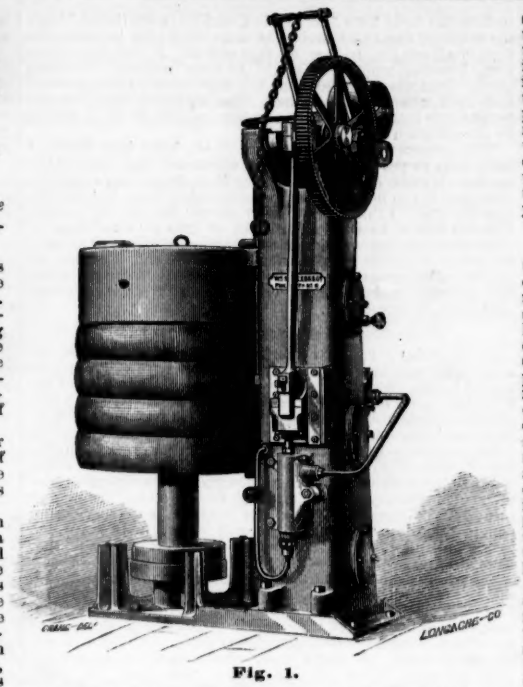


Fig. 1.

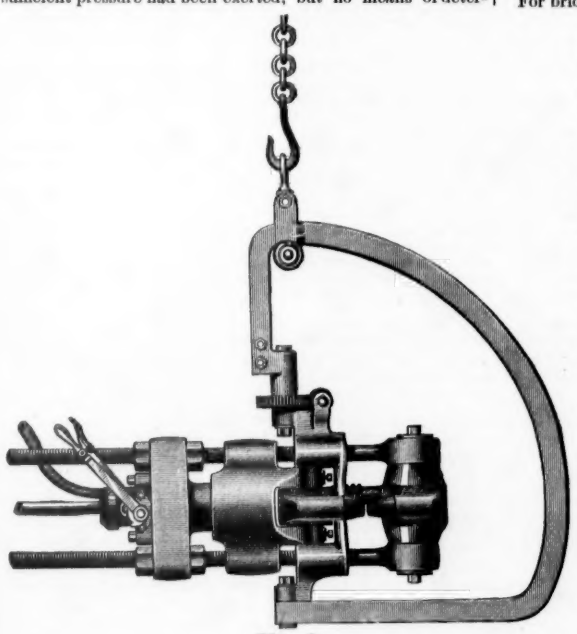


Fig. 2.

Mr. Ralph H. Tweddell, of Sunderland, Great Britain, is the inventor of a hydraulic riveting machine in which is combined all of the advantages and which avoids all the difficulties which have characterized previous machine systems—that is to say, his machine compresses without a blow, and with a uniform pressure at will; each rivet is driven in with a single progressive movement, controlled at will. The pressure upon the rivet after it is driven is maintained, or the die is retracted at will. And to this combination he adds features not heretofore found in any riveting machine.

This machine consists of a riveting die and a holder, one or the other attached to and moved by a piston in a cylinder, which is called the compressing cylinder; this cylinder communicating with an accumulator through a valve, not self-acting, but moved by the operator, so that when the valve is opened the piston to which the die or holder is attached invariably moves until the rivet is headed, with a force which is positively defined by the pressure on the accumulator. Hence the work is performed without a blow; the pressure is uniform whether the rivets are long or short: it can be modified by the weights applied to the accumulator; it is continuous for each rivet, and may be maintained as long as desired, or the riveting die can be retracted as soon as the rivet is finished, whether the pump is taking water, delivering it or at rest.

The accumulator above alluded to is an essential part of the system; it is of variable capacity; in it water is kept under pressure, being forced in by means of a pump, or otherwise. The chamber of the accumulator is closed at one end, and to the other end is fitted a stuffing box, through which plays a weighted piston-rod or plunger. This plunger rises or falls as the quantity of water in the chamber increases or diminishes. By varying the load upon the plunger the pressure upon the water in the accumulator cylinder is adjusted. The water or other fluid under pressure in the accumulator, and there stored ready for use, is conveyed through suitable pipes and admitted by the operating valve to the compressing cylinder of the riveting machine, so that when the valve is opened water flows into the compressing cylinder, closing the riveting dies upon the rivet, and finishing the work with just such force or pressure as the accumulator has been gauged to produce.

The plant required for hydraulic riveting consists, therefore, of an accumulator that can be loaded so as to give any requisite pressure per square inch; a means of keeping this accumulator full by pump or otherwise; and the riveting machine proper, which may be either stationary or movable within certain limits. For boiler work a stationary riveting machine, somewhat similar in construction to our steam riveters, has its large steam cylinder replaced by a very small hydraulic cylinder. The hydraulic cylinder closes the dies quickly, but without any blow.

For bridge-work construction in the shop the pump and accumulator are placed in any convenient position, and the water under pressure is carried through jointed or flexible pipes to a portable riveting machine suspended from an overhead carriage. In using this portable riveting machine the work resting on trestles remains stationary, the riveter is moved along it from rivet to rivet to be driven, performing the work with surprising rapidity and accuracy, and without noise or jar. The whole machine or combination is also arranged for use in the field, by providing a car with boiler, engine, pumps, and accumulator on it, the portable riveter being suspended from a crane or derrick attached to the car. This permits the use of the machine in driving rivets in bridge erection or in ship-building. * *

We have added to the original invention many improvements of our own, pertaining to it, and have arranged convenient overhead carriage and hoisting machinery to facilitate the use of the portable hydraulic riveting machine.

The above cuts and the following description will make the arrangement of the hydraulic riveting machines more comprehensible to the reader:

ADJUSTABLE ACCUMULATOR AND PUMP.

Arranged with weights suspended below the main casting, so made as to be readily released from it, to adjust the pressure to the work being done, each weight represents 250 pounds pressure per square inch on the ram of riveting machine. The maximum pressure obtainable when all weights are in place is 2,000 pounds per square inch.

The pump, which is double-acting, operated by crank motion, is of improved construction, and takes its water from a reservoir in the upright. The return water in entering the reservoir passes through a mass of sponge to filter it. An important feature in the arrangement of pump and accumulator is the adaptation of our improved relief valve to the system. The valve is so constructed and controlled by the motion of the accumulator as to relieve the pump from work without stopping its motion when the accumulator is full, and to start it to pumping into the accumulator as soon as the accumulator weight has descended a short distance. When this valve is open, the water under pressure in the accumulator is shut off from the pump, and the pump, relieved from pressure, draws water from the reservoir and forces it back into the same reservoir, maintaining its action without strain, but ready to resume its work when required. When the relief valve is closed, the pump forces water directly into the accumulator. When the accumulator is full, and no water is being taken from it, the pump must either stop or discharge its water elsewhere. To stop the motion of the pump when the accumulator is full, involves its being again started promptly when required, which is not very readily done, and risks the loss of water and entrance of air into the chamber while standing. To maintain the action of the pump and discharge under a safety valve involves the expenditure of power when no useful work is being done. Our arrangement maintains the motion of the pump ready for immediate action, and yet relieves from strain when not required to do any work.

Fig. 4.

THE PORTABLE RIVETING MACHINE.

We give in Figs. 2, 3 and 4, this useful machine in three positions; showing how it may be adjusted to act readily on seams oblique, horizontal or vertical. Fig. 2 shows the shape of the riveting jaws or levers. The rivet is driven by the dies in short ends of levers. We make these levers or jaws of various lengths, suited to different work. In all cases the proportion of the two ends is as two is to one. Thus, we make a lever 6in. and 12in. long, 9in. and 18in., or 12in. and 24in. These proportions allow plates to be riveted, where the rivets are five in., eight in. or eleven in. from the edges of the sheets or flange edges of angle, tee, or channel bars or beams. It is, of course, desirable to avoid weight of the whole apparatus, to use the shortest and lightest levers adapted to the work in hand. For riveting boiler plates, the stationary machine, with its long and massive stake, as before mentioned, is required. With the dimensions of levers which we have given, there is no trouble in obtaining strength without passing the limit of portability for the machine, so that the pressure on the rivet shall cause the heated and plastic metal to flow into all irregularities of the rivet holes, while only the surplus of iron shall go into the heads.

The portable riveter is suspended from a hoisting machine on an overhead carriage. This carriage having a longitudinal motion on overhead rails, of in some cases 50 feet, and a transverse motion of 6 feet; thus permitting the use of the machine at any point within a space of 50 feet by 6 feet wide.

In this space the work rests on trestles, and the riveting machine is moved along or around it.

One man raises and lowers the riveter, adjusts it to the rivets, and then closes the dies on the rivets.

Boys drop the red-hot rivets into place, with the head uppermost in horizontal work. With a skillful operator, as many as 6 to 10 red-hot rivets may be put in place ahead of him, and he can, on beam work, drive from 10 to 16 rivets per minute.

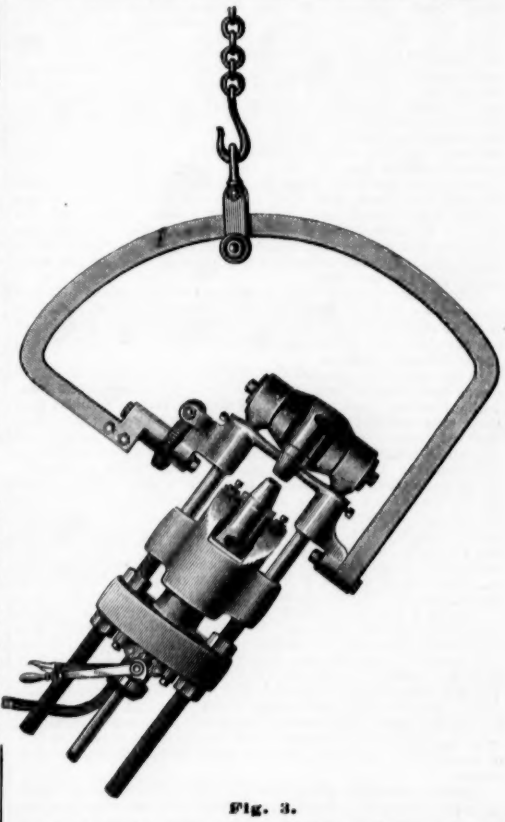


Fig. 3.

The portable hydraulic riveter is suspended from an overhead carriage; the hoisting machinery of this carriage is one of the improved forms of Weston's hoists, working with very little friction, and capable of nice adjustment of the riveting machine to any position.

The same carriage, with slight alteration, can be made to lift 1,000 pounds, and, mounted on the same ways as carry the riveter carriage, can be used to lift and adjust the work to be riveted. To obtain the best result with these riveters, the extra hoisting machines are desirable.

In using the hydraulic riveting machine to advantage, the rivets should be heated rapidly and uniformly. To accomplish this we have arranged furnaces inclosed in sheet-iron covers, with every convenience for rapid handling of the rivets by the boys who attend to this part of the work.

The hydraulic riveting machinery is inexpensive to maintain, if a very little attention is paid to keeping it in order. It, like all other hydraulic machinery, should be kept up, not allowed to deteriorate by careless usage. Slight leaks, if stopped by attention to the packing at once, will give no trouble; if neglected may amount to serious wear from rust and abrasion.

As the portable riveting machine is most commonly applied to especial use, both in place and in description of work, it is better that a full consideration of the requirements be presented to Messrs. Wm. Sellers & Co.; but the form of the machine shown in these pages suited for many uses without change or further adaptation; while the great superiority of machine over hand riveting requires every large boiler or plate-iron working shop to possess in readiness to use all the appliances needed to avoid hand work.

Substitution of Steel for Iron and Iron for Wood in Car Construction.

At the last monthly meeting of the Master Car Builders' Association in New York, Dec. 21, the President, Mr. Leander Garey, in the chair, Mr. Octave Chanute, Chief Engineer and

Assistant General Superintendent of the Erie Railway, spoke as follows on the above subject:

MR. CHAIRMAN AND GENTLEMEN—I thank you for the honor you have conferred upon me by inviting me to address you here this evening, but I am afraid that the little I have to say would hardly have warranted your invitation. I have been asked to make some remarks upon the subject of substituting steel for iron and iron for wood in the construction of cars. Inasmuch as such a substitution would probably involve some important changes in design, it may be well to glance at the past history of wooden cars in order to ascertain how they have arrived to the present design and dimensions. I was very much interested some years ago in a conversation that I had with Mr. Fink, then General Superintendent of the Louisville & Nashville road, in which he related to me his experience in the construction of freight cars. When he first became connected with that road, I think in 1863 or 1864, he was at considerable pains to design the best freight cars that could be made. He had complete drawings made, and he designed a car which, while carrying ten tons, weighed, I think, about 18,000 pounds. That standard was adopted by his road, and he gave strict orders that all cars built in its shops should be in accordance with that model. Some seven or eight years afterwards, I think in 1871, finding that his business increased faster than the capacity in the shops to manufacture cars, he made a contract with some parties for the building of a number of freight cars, to be built, as a matter of course, upon his standard. He had a new car just finished, and he directed it to be sent to the manufacturers; but before sending it he had it passed over the scale and much to his surprise and disgust he found it weighed some 3,000 pounds more than the original standard. He remembered that the trains had been running with about one car less per train than formerly, and he found that, little by little, as his cars were tried by going off the track, the various parts had been slightly strengthened, the scantling of the timber had been increased, an eighth of an inch added to the diameter of the bolts, the castings had been strengthened, etc. I imagine that this illustrates pretty clearly how cars that 25 years ago weighed three to four tons have gradually increased with the exigencies of traffic to ten, eleven or twelve tons.

The platform which carries the load is designed simply as a floor to carry the weight. It is framed with a number of parallel sills without any lateral bracing whatever, and it is designed wholly and simply to carry the superincumbent load. Some of the strains which really occur in use are not taken into account in the design of the car. It is really destroyed by the racking and bumping that it gets, either in switching and in making up in trains, or in going off the track. Now heretofore in our past efforts in the United States to substitute iron for wood in cars, we have simply imitated the old wooden frame. We have adhered to the six or eight parallel sills that were in use in the wooden car, and covered our frame with thin sheets of iron. We have subdivided and multiplied the parts, and the result has been that our iron cars have either been torn to pieces when they have been in a collision or they have been twisted up so badly that they could not be straightened out, or they have rusted away faster than timber would have decayed. We have pursued with our cars precisely the contrary practice that we have introduced with regard to our bridges, which are built with a view to concentrating the weight upon as few parts as possible.

I think that we shall have to change the framing to a certain extent if we wish to introduce iron in place of wood in cars, and that we shall substantially have to introduce for the framing of our cars the same principles which have been so successful in the building of bridges.

In the course of a recent visit I became aware that the Europeans had designed cars upon different principles from those which thus far have obtained in this country. I found that their cars not only weighed considerably less than ours, but that they cost only about half as much to keep in repair, and that the estimate of their life was double that which obtains in this country. I have here a plan of a car which I consider about the best of the European iron cars, which I shall be very glad to leave here for the master car-builders, of which the following is the description: Length inside, 23 ft. 4 in.; width inside, 8 ft. 4¾ in.; height at sides, 6 ft. 11 in.; height at centre, 7 ft. 4 in.; height of doorways, 6 ft. 6¾ in.; width of doorways, 4 ft. 11 in.; distance between centres of sides, 6 ft. 5½ in.; diameter of wheels, 3 ft. 2⅝ in.; wheel-base, 13 ft. 1¼ in. (M. C. here described the car at length.)

I saw in a number of places in Europe a good many iron cars. I found but few in England. In France about half their cars are built of iron; and in Germany nearly all of them, I think. The weight of the German box freight car (I took the figures from the sides) is 15,984 lbs., the maximum load, 22,074 lbs. The flat cars weigh 13,117 lbs., and their allowed load is the same. The Gondola cars weigh 13,448 lbs., and the weight of load is the same. The cost of repair of these cars was stated by a master mechanic whom I met in Germany at one-quarter of a cent per mile run, and the life I think he stated at 30 years.

Now the principles which underlie the construction of European cars are these: First, they concentrate the iron they use into as few parts as possible. They only use two sills, and they make those do all the work. Secondly, they put all the strength of the car in the platform, that portion of the car which takes almost all the strains and all the shocks when going off the track, is made sufficiently strong to carry the load, and at the same time to take the shocks and strains which are liable to occur in practice. The third principle is that they brace against those strains. Instead of sills merely tied parallel to each other, they brace them together diagonally. The fourth principle is that they make no use of the box part of the car, except as shelter for the goods. They do not pretend to derive any stiffness or strength from it. The box portion is stiffened to stand the racking which it may get in the train, but no dependence is placed upon it as adding to the strength of the car. So that if it gets into an accident the upper portion of the car may be sheared entirely off without injuring the frame or the strength of the car itself. If, instead of the framework described, they could use a tent, I believe they would resort to that. (I found, in fact, in England they did resort to tarpaulins. Three-quarters of the freight there is carried in gondola cars with tarpaulins, with a saving in loading and unloading of about half the cost.)

These details and plans of European cars refer wholly to four-wheel cars. I do not believe that it is practicable to go back to four-wheel cars in this country. We have made a very material improvement in adapting the truck. The question occurs whether it is not possible to introduce the principles which underlie the construction of European cars in the construction of American cars.

The first fact which is prominent in this respect is, that we have eight wheels to carry a load instead of four, and it seems wise to make use of the fact by designing a car which, while running upon eight wheels shall increase the load to be carried. More to illustrate my meaning than for any other purpose, I have had some designs made which will be laid before you this evening, showing the way in which this European method of framing iron cars might be applied to our eight-wheeled cars. The designs to which I allude represent cars intended to be of the capacity of 30,000 lbs., and I think they will weigh about 19,862 lbs. Some incidental advantages arise from this mode of framing by dispensing with the bolster which is in use in modern cars. For instance, the truck can be dropped down immediately upon the channel bars. It thus becomes possible to drop the body from 5 to 7 inches, and if it were deemed best, the result of the introduction of iron, might be to lower the floor of all our freight cars to that extent. It will be a question, however, whether it would be wise to lower the drawhead. It seems more judicious to adapt instead a larger wheel than that which is now in use. The standard wheel in our freight cars is 33 inches; it can be increased to 38 or 40 inches, by the adoption of iron framing.

With respect to the substitution of steel for iron in cars, I believe we as yet know too little about the properties of the steel, and what can be done with it, to determine exactly in what way it can be most economically introduced in substitution for iron. I think our efforts should be for the present directed rather to the substitution of iron for wood than for the immediate introduction of steel. The substitution of steel for iron will follow as a matter of course, and probably by process of experiment it will be developed in what parts it is best adapted, and the methods by which it can be most advantageously introduced.

DISCUSSION.

At this point a recess of ten minutes was had, to give the members present an opportunity to examine the designs presented by Mr. Chanute. At the expiration of the recess the President, after calling the members to order, remarked that any innovation upon established custom invariably drew upon itself the most determined opposition from all quarters.

MR. FORNEY.—In regard to this being an innovation in the manufacture of iron cars, I suppose it might be well to adopt the plan upon which many engineers and mechanics proceed—to condemn every new thing that comes along, for 19 new things out of every 20 are good for nothing, and therefore a person adopting that principle will be right 19 times and wrong only once. I judge from the general tendency that seems to prevail, that the use of iron cars will simply be a matter of time. A short time ago I had a letter from a friend, asking my opinion about it. I remembered that twenty-five years ago on the Baltimore & Ohio road they used iron coal cars, or coal hoppers as they called them, and I think they have been using them extensively ever since. Those iron coal cars were built 25 years ago, when wood was a good deal cheaper than it is now, and iron a good deal dearer. It seems to me therefore that the use of iron cars must be much more profitable now than when they used them. I have a drawing of one of those hoppers which, perhaps, some of you know about. If the cars were profitable at that time they ought to be so now. The plans you can examine at your leisure. This (referring to a drawing upon the black-board) is the figure of a dump car that was sent to me by Mr. Richards, of the Boston & Providence Railroad. He has made a very useful and ingenious application of iron to the car, which consists of arranging two longitudinal channel bars over the frame of the car to attach the drawheads to. He does that because it is necessary for these drawheads to project so far beyond the end of the car that they are broken off very often; and then simply two channel bars are put through and the draw-head is bolted fast to them.

My own impression is, from what I have been able to see, that the introduction of iron cars will be gradual. I know that some years ago on the Burlington & Missouri River road they built some cars with the trucks made on that principle (sketching truck upon the blackboard.) There were two channel bars put in which formed the transoms. I have no doubt most of the car-builders present have seen those trucks. I used the same arrangement on a locomotive truck which had outside bearings. It is a very cheap arrangement, and also a very good one. You know, too, about using channel bars and I beams in tender frames. The Rhode Island and other locomotive works have built a great many of that kind. My impression is that the introduction of channel bars and I beams, etc., will come about in that way until we get a car composed chiefly of iron. The difficulty about using the iron in cars will be about the same as in bridge-building. You will remember that in the models of car frames which we tested here last year they were very good except the fastenings of the parts. As soon as those frames were subjected to a strain, the fastenings gave way. It was the same way at first with iron bridges; they always broke at the fastenings. The results showed that although the scientific calculations were all right, the details are the all important considerations. Attention must be given to them as well as to scientific principles.

MR. PARTRIDGE.—I have had Mr. Forney's experience in condemning the twenty inventions and being nineteen times right, but in the designs for cars that have been shown this evening I shall depart from my usual practice. This is a radical departure from our wooden car-building, but while it is unfortunately true that we shall attempt to use more and more iron in our cars, we shall go astray just so much as we do that. We put iron and wood together in a box car—half and half. We do not make any sort of attachment. We couldn't put them together with any kind of satisfaction, for the wood would be continually getting short by shrinkage and the iron doesn't pay any particular attention to age; and the result is railroad constructions in which iron enters largely are essentially weak and usually bad in design. Our wooden cars are good wooden cars, and the amount of improvement we can give them, as in bridge-building, is matter of detail. If we can make an iron car, we must use the iron constructively and the wood come in incidentally. The constructive principles that are involved in the improvements are altogether different. In fact the very nature of iron requires a radical difference in the plan, and the sooner we leave one entirely and take to the other the better it will be for the cars which we build. The cars built upon the channel bearing plan will scarcely be desirable. I have seen iron cars built on the plan of a wooden one, supported on a wooden bolster only; but finally the wooden bolster turned down at the ends, leaving the whole weight of the car to be carried by the centre sills—the whole load of the car carried from the centre-plate in that circuitous way utterly unsupported by the bolster, which was intended originally to form a part of the frame. That is a very good illustration, perhaps, of the uselessness of putting wood and iron together in a frame constructed in that way. The idea of taking the main member of the frame from the outside and placing it in an intermediate position is a very good one, and it enables the construction to be not only materially lightened, but the strength and resisting power of the sill or channel beam is very greatly increased.

MR. L. GAREY.—The introduction of cars designed to carry more load is, as I have expressed myself here several times, in my opinion the right direction in which to reduce the dead weight. There are four-wheel freight cars now in service in this country weighing from 9,450 to 9,650 pounds and carrying eight net tons. There are quite a number of eight-wheel cars carrying 15 tons successfully. To increase the carrying capacity say ten to fifteen tons by introducing a longer car I should think very desirable.

Mr. Wilson, of Pittsburgh, exhibited some specimens of iron and steel combined which his firm—Wilson, Walker & Co.—are manufacturing. The central portion of the bars consisted of steel surrounded by wrought-iron and all welded into one bar. They had found the tensile strength of a piece of the metal, which he exhibited, to be 115,000 lbs. He was now making some experiments in axles by the same process, having the steel cored through each bar of iron in the axles and welding it into one mass under a heavy hammer. He believed that a transom made of this metal could be reduced one-half to five-eighths. The steel by this process retained all the carbon that was originally in it. It is easily welded. One great advantage it possessed was the facility with which it could be manipulated. The iron always follows the form of the bar, no matter whether it be T iron or angle bar.

Upon the suggestion of the President, Mr. Walter Youmans, a philosophical-looking gentleman, exhibited some models of a truck of his designing, and proceeded to explain the same with much loquacity. In the course of his remarks he proved to his entire satisfaction that the theory of railroads was wrong from beginning to end, and enunciated many other views equally striking for their originality.

MR. FORNEY—I should like to ask of the car-builders present what is the cost per one hundred or thousand miles for wheel service; that is, what does it cost per mile for cast-iron wheels and how much does it cost for steel wheels?

MR. CHAMBERLAIN.—One of Mr. Krupp's representatives, Mr. Jones, is here, who has probably some information that he might be able to give us of the cost per mile of steel wheels in the old country. So far as the cost of iron wheels is concerned, I never figured it up, and no steel wheel has ever been worn out in this country.

MR. JONES, upon being called upon by the President, stated that the average mileage of steel wheels in Europe was 500,000 miles, and that the wear of the steel wheel on the rail was considered less than the iron wheel. The size of the German wheel is 38 inches. The cost of a 38-inch solid steel wheel would be $53 gold, and the weight would be 884 pounds. The wheels that the firm which Mr. Jones represented sold principally in this country were 30-inch wheels, weighing 547 pounds and costing $44 gold.*

MR. CHANUTE.—If these wheels can make that mileage they would be materially cheaper than our cast-iron wheels. Assuming the latter to run 60,000 miles, they would cost a quarter of a cent a thousand miles, while if they can run at the rate of 300,000 they would cost 1-16 of a cent per thousand miles.

MR. FORNEY.—Is 60,000 miles a fair average to attribute to cast-iron wheels? I find that there is a difference of opinion with reference to that question.

MR. CHANUTE.—I think the average is somewhat under 60,000 miles.

MR. FORNEY.—It has been estimated in this room by practical wheel manufacturers that it does not exceed 40,000 miles.

MR. CHANUTE.—They were predicating their opinion probably upon the failures.

MR. FORNEY.—And it is also true that the wheels that give the biggest mileage only come in at the latter end of the account and thus increase the average.

MR. CHAMBERLAIN.—I know that I am one of the unfortunate victims that cannot get a cast-iron wheel to run 60,000 miles. I know positively that the average of some makers has increased 20,000 to 30,000. But I cannot find any wheel that will give an average of 60,000. For eleven months the average of 2,000 wheels has been 49,440. The greatest number of any one wheel has been 91,589. The cars weighing from 40,000 to 45,000 pounds. On passenger cars the smallest mileage of any one is 8,228. The wheels I speak of are now all worn out.

MR. FORNEY.—But if you were to put 500 wheels under your cars and take the average of 400, your average would not be as large as if you took the average of the whole 500.

MR. CHAMBERLAIN.—My experience is that it decreases instead of swells.

MR. FORNEY.—The trouble is that the accounts of our roads have not been kept long enough to give a correct indication of the number of wheels that have been worn out.

MR. GAREY.—I was conversing to-day with the gentleman to whom Mr. Forney has reference, and he stated it at from 40,000 to 45,000 and he was of opinion that the general average had increased owing to the particular attention that had been given to the manufacture of the wheel and the selection of the iron to perhaps 30 per cent. greater mileage than it was two years ago, before the subject was discussed in these rooms.

MR. HOPKINS.—I suspect that one important feature of the steel wheels will be the uniformity of the size of the two wheels. Some years ago I took occasion to observe cast-iron wheels with much care, and I found that a difference of a quarter of an inch in the circumference of the two wheels would involve an extremely rapid wear of the smaller wheel, so that it would not give more than half the service. I found also that the flange of the smaller wheel would hug the rail more than the other.

The next meeting will be held Thursday evening, Jan. 18, 1877.

* Since the meeting was held, Mr. Jones has requested us to modify the above statements, for which he was called upon unexpectedly, and which were not prepared with any memoranda or written data. On examining into the matter he finds that there are now about 100,000 solid cast-steel disc wheels in use in Germany. The Imperial Board of Directors of the Upper Silesian Railroad report that their first employment dates from 1859, when 92 pairs of wheels were put into use, of which each has, up to the time of the report, run on an average of 310,000 miles. They are still in use, and it is said their wear is very light and that no material error would be made if the average life of these wheels was estimated at 500,000 miles each. These wheels are probably 38-in. diameter, as that is a standard size in Germany. The following is the price at which wheels of the sizes and weights given can now be furnished in this country, delivered in New York:

30-in. disc wheels,	547	lbs.	weight			$44	gold
33 "	"	"	597	"	"	47	"
38 "	"	"	884	"	"	53	"

—EDITOR.

Contributions.

The Justifiable Expenditure for Improvement in the Alignment of Railways.

BY ARTHUR M. WELLINGTON, C. E.

(*Continued from page 545.*)

ASSISTANT ENGINES (CONTINUED.)

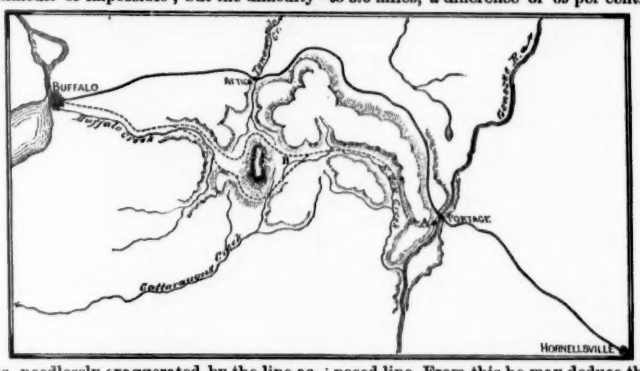
As a first example of the economy which may result from the use of assistant engines, we propose to consider a possible new location of the Buffalo Division of the Erie Railway, as determined in part by an experimental line which was run some three or four years since, but abandoned as worthless. Circumstances needless to go into led the writer to become thoroughly familiar with the possibilities of the line at the time, but he has since had no reason to remember the facts in detail, nor has he, unfortunately, preserved any notes of the line whatever. In respect to details, therefore, he is now obliged to rely solely upon his general recollection of what he then knew to be possible, but at the time he took much interest in the question and can vouch for the substantial correctness of the facts as stated.

The general features of the lines which we propose to compare are shown in the accompanying outline map and profiles,†

† The map and profile 2 are sketched only from memory and are probably inaccurate in detail. The writer has no large scale map at hand and no exact recollection of the elevations and distances over the proposed line.

and may be thus described. The present line is about 91 miles long, and for 30 miles of this distance follows a very direct and easy route from Hornellsville on nearly an air line towards Buffalo, as far as the crossing of the Genesee River at the well-known Portage bridge. From this point westward the line makes a wide divergence to the north, in order partly to avoid the high summit on the direct line, descends into and out of the valley of Tonawanda Creek at Attica, and thence takes a nearly direct course for Buffalo, running in all a distance of 61 miles from Portage in order to make an air line distance of from 42 to 45 miles. The line which we now propose to compare with this leaves Portage bridge by an abrupt turn to the southward, passes over the summit ridge between the East Coy Creek and the Genessee River at a slight depression marked A (reaching this point by a short run of 1⅛ to 2 miles on almost any grade which may prove convenient), and runs thence some 20 or 24 miles through a very practicable valley to the point marked B. In this valley we may secure nearly such gradients as we please and find to be subsequently desirable.

At the point B we are in a series of summit swamps, lying immediately under and not very far from the top of a hill very justly known in the neighborhood as the "backbone of Western New York." It is the highest point in the State west of the Genesee River, and the water runs from it into streams flowing in four different directions. These streams are: first, the Tonawanda Creek, running north, and crossed 10 miles below by the present line of the Erie Railway; second, the East Coy Creek, running east, up which we have just ascended; third, the Cattaraugus Creek, running south; and finally, the Buffalo Creek, which, by a moderately circuitous, route runs directly west to Buffalo. All but the last of these four creeks head together in the swamps at B. The Buffalo Creek, on the contrary, lies in an extraordinarily depressed valley directly west of the summit hill, and runs thence sluggishly towards Buffalo. The outlook into this valley from the summit hill is of the most formidable description, and any regular descent westward is evidently difficult or impossible; but the difficulty



which really exists was needlessly exaggerated by the line actually run, for, by an inexcusable oversight, it was run almost over the top of the summit hill and directly down into the valley, showing a profile which would strike terror to the heart of the engineer of an inclined plane.

Nevertheless, these peculiar topographical features offer us great advantages. By swerving our line either to the north or south in the neighborhood of the point marked B, we may, without any difficulty whatever, and with a much shorter line than that actually run, pass through the summit swamps at B into the water-shed of the Cattaraugus or Tonawanda Creeks, and, keeping to the smooth sides of the summit hill on pretty much any grade we please between 50 and 100 feet per mile, pass over the subordinate and much lower summits between those streams and the Buffalo Creek, and running down on the same grade to the bottom of the valley at the point C we may continue on into Buffalo on any grade selected over 20 feet per mile without any considerable difficulty, the line throughout being a cheap line and from 2 to 8 miles shorter than the present line, according to the gradients adopted and other modifying circumstances. Let us see what can be done with this line with well-adjusted grades.

The first question which arises is as to the weight of traffic in each direction. In 1855 this ratio was 10 tons east to 3 tons west, as an average of the whole road. Since that period the disproportion has shown a steady tendency to increase on its rival railways (as will be seen by referring to Table XXI.—A, page 491), and this tendency will in all probability continue. On the other hand, there is a considerable local tonnage westward towards Buffalo, and a large and probably increasing coal traffic westward; but we will consider later if the gradients cannot be made more favorable than at present for the coal business also, *i. e.*, for an unequal traffic in *both* directions, and assume that the present disproportion in through freight over the Buffalo Division is as 1 to 3. With this disproportion given, we find by Table G, page 491, that the grade going west opposing an equal resistance to 20 feet per mile rising eastwardly is 42 feet, which latter is the grade we may freely use, so far as *through freight only* is concerned. We will increase these gradients, however, to 22 and 45 feet per mile in order to be certain of not assuming the impossible. From the point C to the summit we will assume that a "pusher" is used 20 per cent. heavier on the drivers than the regular through engines. With such a pusher the corresponding grade to 22 feet is, by Table K, page 544, 70 feet, which will therefore answer our purpose as well as a lower grade. From the summit eastward to the point marked A, we may use any grade under 22 feet per mile going east and 45 feet per mile going west, which are far above those actually required for the lightest surface line. In ascending to A from Portage with a pusher similar to that assumed above, the grade of equal resistance to 45 feet is 109 feet (Table K), which we will therefore use. This grade will also be seen in Table G to be the exact equivalent of 70 feet going east, for the given inequality in traffic. Beyond Portage, we have no grades up to or even approaching 22 and 45 feet per mile, except at a few points easily reduced, and we thus pass into Hornellsville at a distance of from 85 to 88 miles from Buffalo. We will say 88 miles.

Let us first determine from the tables we have given the difference in operating value of these two alignments. We have:

In favor of proposed line, 26 feet increase in ruling grade over 22 feet:

Value, by Table E (p. 456), \$10,340 × 26 × 91/100 = ... \$244,644

Do., 3 miles of distance:
Value, by Table A (p. 389), \$3,900 × 3 11,700

Total \$256,344

In favor of present line, 9 miles assistant engine service:
Value, by Table L (p. 544), \$4,364 × 9 39,276

Net balance in favor of proposed line, per daily train .. \$217,068

As to the number of daily trains, the cost of running which would be affected by this improvement, the writer has no definite information, but we may roughly assume, from the data given in Table I, page 521, that there are 6 passenger, 20 freight and 4 coal trains daily over the Buffalo Division. For passenger and coal business we have not as yet improved the line to any important extent, and we will neglect them altogether. The 20 freight trains over the present line, however, may be readily determined from Table D (page 442) to be equivalent to 20 ÷ 1.625 = 12.3 trains over the lower grades of the proposed line, and we have as the value of the proposed line, for freight business only:

\$217,068 × 12.3 = \$2,669,936.

Now, if the reader will figure out the present cost of running 20 freight trains over the Buffalo Division, at the low estimate at \$1.00 per train mile, he will find it to be \$1,183,000. If he then figure out the respective number of cars to a train on these lines, by any standard he chooses to adopt, he will find it to be about as 19 to 31, and he will also find the engine mileage per car moved and returned over the division to be as 9.45 miles to 5.6 miles, a difference of 69 per cent. in favor of the proposed line. From this he may deduce that the yearly saving on the proposed line would be \$483,000 if all expenses varied with the engine mileage, but as only 48 per cent. varies therewith, the net yearly saving will be \$231,840, which, capitalized at 7 per cent., gives \$3,312,000. The excess of about \$600,000 in this rough process over the estimate above is simply due to the fact that it confuses the expense account and the mileage account in many minor details, which we cannot go into without retracing our whole argument.

But we have as yet far from exhausted the possibilities of the line proposed. The Erie Railway has a large coal business which requires, for its economical transaction, unequal gradients in the opposite direction to the freight traffic, and it has also a large passenger business, which requires equal gradients each way. In order to adapt the line to these diverse requirements we will readjust the gradients shown on Profile 2, by the aid of Tables G and K, in the manner shown on Profile 3. We will increase the low grade going east from Buffalo from 22 feet per mile to 35 feet per mile; and we will also increase the summit grade from 70 feet to 93 feet per mile. On what we may term the summit level—because it is not a level—we will use grades of 26 feet per mile descending east and 6 feet per mile ascending, and we will increase the grade on the two-mile descent to Portage Bridge from 109 feet per mile to 117 feet per mile. Between Portage and Hornellsville we will—by improvements neither very costly nor difficult—reduce the grades to the same as those used on the summit level, viz., 6 and 26 feet.

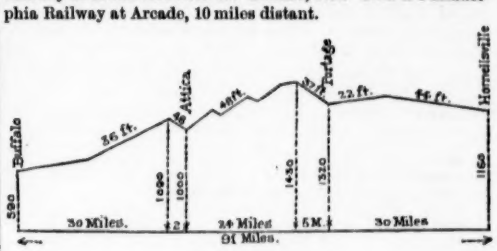
Now in readjusting these gradients we have violated what is almost an axiom by materially increasing the grades opposed to our heaviest traffic, and yet it may be shown that Profile 3 is decidedly preferable to Profile 2 for freight business alone. Moreover, we have a line on which the ruling grades each way are much over 20 feet per mile, even without considering the heavy summit grades; and yet it may be shown that this line has a higher operating value than if it were reduced to that *summum bonum* of routine engineering, a low summit line with ruling grades of 20 feet per mile each way. We do not say, nor believe, that the grades shown in Profile 3 are in all respects the *best* which can be done in this particular line, but we propose to assume that they are so, and show what an admirable line it is as it stands, in order to illustrate how cheap and excellent lines may be secured through difficult country by a careful adaptation to each other of the special topographical and operating conditions; by adapting our requirements to the ground, and not starting out with a barometer and a lantern to find ground which we may force at great cost to conform to inflexible requirements.

We will first consider the value for freight business of Profile 3, as readjusted; and inasmuch as estimates from our tables will carry conviction to no one but the careful reader of our previous papers, we will hereafter estimate on the basis of the motive power required.

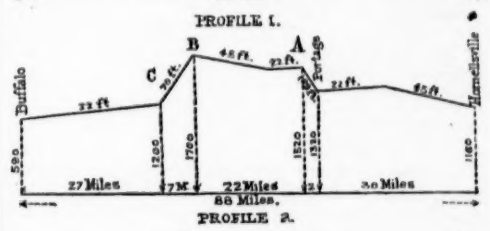
The normal freight train over Profile 3 would consist of 48.3 cars corresponding to a ruling grade of 6 feet per mile according to the standard used in preparing Tables XVII. and XX. (pp. 442 and 457), as against 19.3 cars over the present line with 48 feet maximum grade. We retain the fraction in order to show the exact proportional difference in net load due to the difference in grade.

This train we will run from Buffalo to the summit in two sections of 24 cars, and each of these sections again is pushed up the summit grade by a pusher 20 per cent. heavier on drivers than the regular engines. Tables G and K will show these grades to be exactly proportional to this work. From the summit eastward, 56 miles, these two sections are combined into one train and find no opposing grade exceeding 6 feet per mile. The engine of one of the sections returns light to Buffalo, and we will assume this to be dead loss, although it may be utilized in many ways.

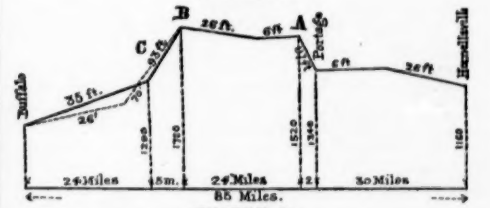
The same train of 48.3 cars returning from Hornellsville is only 3-10 loaded and encounters no heavier gradient at any point than 26 feet per mile (corresponding to 6 feet coming east), except at Portage, where two pushers 20 per cent. heavier on drivers than the regular engines will push the train up the 117 feet grade for two miles to the summit level. Thus we require pushers at only one point each way, first at Portage, where all trains stop at present, and secondly at the foot of the summit grade, which is also a natural stopping place, and where an abandoned road-bed which has been graded and bridged for 20 years connects with the present line of the Erie Railway at Attica and with the Buffalo, New York & Philadelphia Railway at Arcade, 10 miles distant.



PROFILE 1.



PROFILE 2.



PROFILE 3.

The engine mileage required to run a train of 48.3 cars from Buffalo to Hornellsville and return, would be as follows:

	Distance	Mileage, at Work.	Mileage, Returning Light.
Buffalo to Summit (2 sections)..	29 miles.	58 miles.	29 miles.
Pushers on Summit grade.....	5 "	10 "	10 "
Summit to Hornellsville..	56 "	56 "	
Hornellsville to Buffalo.....	85 "	85 "	
Pushers at Portage Grade	2 "	4 "	4 "
Totals (in all 256 miles).....		213 "	43 "

Equal to 5.34 miles per car moved and returned over the division.
Over Profile 2 (as previously determined) 5.6 miles per car.
" present line " " " 9.45 " " "
" " " " reduced to 20 ft. maximum throughout (normal train increased from 19.3 to 32.8 cars) 5.56 miles per car.

We will now consider coal traffic, which by our rough guess is four trains daily. At present these trains encounter a maximum of 48 feet per mile, but by not very expensive improvements this might be reduced to 30 feet per mile, except for two miles of 48-feet grade at Attica, and we will assume the present line to have been thus improved. On this grade a full train will consist of 528 tons, or 29.3 coal cars of 18 tons each, by the same standard which we have used throughout (Table XVII., p. 442). On Profile 3 the maximum grade encountered by coal trains is 26 feet per mile, and the load will be 8 per cent. greater than on 30 feet, or 31.7 cars. But when a coal train has reached the summit on the line shown in Profile 3, we have no necessity to run the coal engine any further. From that point we have a continuous descending grade into Buffalo, and might even run the coal cars down by gravity, but as we have a number of freight engines daily returning light, we may use them to run in coal trains without any cost whatever. To get the empty cars back, we may introduce a special modification of the gradients between Buffalo and the summit, which will enable the regular freight engines to haul them back in sections of half a train, more or less. Sixteen empty coal cars would add the equivalent of 6 loaded cars to a half train of 24 cars, or increase the load 25 per cent., and the corresponding reduction in grade required would be from 35 feet per mile to 26 feet per mile, and from 93 to 75 feet. These reductions are attainable without cost in money or distance, and have not in any manner affected the cost of moving freight eastward nor disturbed the balance of the

skeleton outline of gradients shown in Profile 3. We have simply introduced a special modification for a short distance, to accommodate the special requirements of a particular branch of traffic.

The engine mileage to move a coal car from Hornellsville to Buffalo and return would then stand as follows:

Hornellsville to Summit	56 miles × 2 = 112 miles.
Portage grade (2 pushers)	4 miles ×2 = 8 "
Total for a train of 31.7 cars (3.8 miles per car)	120 "

Over the present line, 182 + 4 = 186 miles to move 29.3 cars = 6.4 miles per car.†

Now with reference to passenger business over the proposed line: we cannot modify the weight of passenger trains to suit gradients, as we can do with freight trains, but we can modify the weight of passenger engines, and thus effect a nearly equal economy. By the modification we introduced in Profile 3, to accomodate the requirements of the coal traffic, we have also secured a profile for passenger business with balanced maximum grades of 26 feet per mile each way, except on two short planes worked with assistant power. By the present line the maximum is 48 feet per mile, and *whatever* may be the weight of passenger engines found practically advisable over the present line, it may be reduced (by Table XVII.) to 61÷90.8=67.2 per cent. of the present weight, a saving of 33 per cent. We have estimated the value of reducing the weight of through engines to be 45-50 or 90 per cent. of the value of reducing their number, and 90 per cent. of 33 per cent.=29.7 or about 30 per cent. Against this we have 14 miles of assistant engine service in 192, or nearly 7 per cent., leaving a net saving of 23 per cent. in passenger motive power. These assistant engines are attached for short runs of two and five miles at regular stopping places and cause no delay nor inconvenience, while a simple computation will show that the regular freight pushers would have ample power to run passenger trains up the incline at 25 or 30 miles an hour; but the inclines are so short that even if there were some loss of speed it would have no appreciable effect on the average time.

Recapitulating these items we have as the net difference between the present and proposed alignments:

Number and class of trains.	Engine mileage per car round trip.		Percentage of saving in engine mileage.
	Present line.	Proposed line.	
20 freight trains	9.45	5.34	0 43
4 coal "	6.3	3.8	0.40
6 passenger "	.....	.....	0.23
Average for 30 trains			0.39

The "line expenses" of the Erie Railway (including all expenses except station, terminal, general and taxes) are very close to 80 cents per train mile, and the corresponding yearly cost for those expenses of operating the present line, assuming 30 trains daily, is 80 cts × 91 miles × 2 × 325 days × 30 trains = $1,419,600.

We have already seen, on page 436, that 5-7 of this amount varies directly with the engine mileage. Hence, we should save of the above amount, 5-7 of 39 per cent. = 28 per cent. yearly = $397,488. This amount, capitalized at 7 per cent., gives $5,678,400 as the difference in operating value in favor of the proposed line. More careful attention to details, or an estimate from our previous tables, would reduce this amount about 15 per cent.; but, on the other hand, we have neglected to consider what is in effect an increase of grade in the present line, arising from unreduced curvature, and some minor sources of error, so the balance is about equal. Nor is this result due to a combination of fortunate circumstances, for we may reverse all the conditions of traffic and obtain a still greater advantage over the present line, although the gradients would be entirely different in detail, and the line, if laid down upon the ground, would undoubtedly require an entire relocation from end to end.

Now this large sum means that injudicious location has *cost* the Erie Railway over $5,000,000, as truly as if the money had been thrown into the sea. For the proposed line is a much cheaper line to build than the present line, and the new line which would now be required could probably be finished to sub-grade throughout for $800,000, or only two years' saving in operating expenses. If this be so, we may stop to consider what is the reason of such marked economy in a line passing over almost the highest point in Western New York. It lies simply in this—that we have *concentrated the resistances.* Every engine while running is kept fully at work, and the gradients are so situated that the greater portion of the work to be done in running either way is concentrated on a portion of the division, and for the remaining distance we have little more need of an engine than to keep the train under control. Therein lies the secret of the economy which may be realized by the skillful use of assistant engines. It is a truth of the first importance that the objection to high gradients is *not* the work which engines have to do on them, but it is the work which they *don't* do, when they are thundering over the track with a light train behind them from end to end of a division, in order to be at hand at a few scattered points where their power is needed, and in the meantime expending their superfluous energy upon the track. But if we may give this additional motive power its work to do once for all, and have done with it, high summits cost very little, and an increase of the rate of grade costs nothing whatever. In very many instances the whole loss is more than repaid by a saving of distance, as in the present case, and there is this further great advantage in thus concentrating resistances for the use of assistant engines, that by so doing we may *cheaply* obtain what is equivalent to a line with very low ruling grades, because at the points of *greatest difficulty* we are independent of the rate of ascent, and in great degree of the elevation attained, and are therefore at liberty to concentrate all our efforts and expenditure on the more tractable portions of the line, where a few feet per mile reduction in grade is of enormous value. In this manner it is in every way practicable to secure lines over high summits and in difficult country which shall approximate closely in operating value to a line on a dead level throughout. For any level line must inevitably be so complicated by curvature that the equivalent straight grade would be from 10 to 20 feet per mile, whereas on many high summit lines worked with assistant power we may, by virtue of the leeway as to rate of descent which our elevation gives us, realize for a considerable portion of the distance the full benefit which we should derive from a straight and level track. Low grades are so frequently complicated by unreduced curvature that few appreciate the great difference which a few feet per mile reduction in very low gradients makes in the net load of engines. For example, if Profile 3 be examined, it will be seen that the *limiting* gradients—the ones to which we have been obliged to adjust all the others for fear of exceeding the topographical possibilities—are the very lowest of them all, viz., those on the summit level and east of Portage. Now *if* we can reduce these low grades from 6 and 26 feet to level and 13 feet per mile, we shall effect an enormous economy in operating expenses, because we could probably without much difficulty reduce the other and higher gradients to correspond therewith, and the regular load of engines over the whole line would be increased by the difference in the loads which it can regularly haul on grades of 6 feet per mile and level, which is 190 ÷ 153 = nearly 25 per cent. greater. In order to effect a similar saving in operating expenses on the present line with 48 feet maximum grades, we should have to reduce these grades by 13 feet per mile, and as this reduction would have to be made at the most difficult points on the line, it would probably be attended with many fold the expense of reducing our lighter gradients 5 or 6 feet per mile. Therefore, if we can reduce those lower grades without excessive cost, there is the place for unhesitating expenditure, leaving the heavier gradients on the short sections of rugged and difficult country to take care of themselves. We may thus obtain out of the high-summit Buffalo Division a line closely approximating in operative economy to the low grade Susquehanna Division, which has ruling grades of 6 feet per mile indeed, but so complicated by unavoidable curvature that a locomotive which would haul 48.3 cars over the straight 6 feet grades shown in Profile 3 would haul less than 40 cars over the Susquehanna Division, so that to move one car 85 miles and return would take 170÷40 =4.25 engine miles. On the other hand, if we can reduce the 6 feet grades of Profile 3, through a few miles of easy country, to a level, reduced to a descending grade on curves, we shall be able to increase our normal train from 48.3 cars to the full level load of 60 cars. The mileage of engines, however, remains the same as before, so that the engine mileage per car round trip of 85 miles would be only 256÷60 = 4.27 miles, as against 4.25 miles over an equal distance of the Susquehanna Division.

Now if this ultimate economy be not attainable on the particular line which we have been considering, it is in many instances, and more attention should be paid in location to these possibilities of economy. It is time that these high elevations which we cannot avoid altogether should be put into the treadmill and made to do duty. It is possible to do so, and the possibility should be kept in view on *all* lines through difficult country. For that country is rough indeed through which a line cheap to build and economical to operate cannot be obtained by looking for it, if, *first*, we determine exactly what is required by special investigation of each case, and, *secondly*, seek for no more than that, nor spend a dollar to obtain it. But if we attempt to defy the obstacles of nature by forcing them to conform throughout to the Procrustean standard of a uniform ruling gradient, we enormously increase the cost of construction, and in the end find that we have a far more costly line to operate than if we had "stooped to conquer" by boldly conforming to the topographical conditions and then skillfully forcing them to serve our purpose. We may thus obtain many of the advantages of the gravity railroad, and in order to do so the true policy in very many instances in difficult country is to make boldly for the "meeting of the waters" at the summit, and by thus concentrating our resistances, have *most* of our line on very favorable grades,—instead of zig-zagging up and down and from side to side in search of a costly approximation to the impossible, viz., a line of *uniform* low grade through a hilly or mountainous country. Such a line never has been found, and it is safe to say it never will be.

We know of no more forcible illustration of the correctness of this principle than may be found in the alignment of a great railway now building, the moral from which is so important that we feel bound to consider it in some detail in the following paper. It furnishes a remarkable example of the art "how not to do it" with the utmost care, if we keep but one end in view instead of giving full consideration to all the possibilities. This is also true of the line which we have just been considering. The engineer who made the survey started out with the definite purpose of finding a line with 20 feet maximum grades. In order to do it he made a detour at the very beginning which sacrificed eight miles of distance, in order to reach the point marked A on the map above; and yet even this process, continued throughout the survey, could not produce a line with 20 feet maximum grades, although it *did* show a very absurd and worthless line. Consequently this territory stands reported as wholly worthless for railway purposes, with maps and profiles to prove it abundantly, and yet a better line than if he had actually obtained his 20 feet maximum without sacrifice of distance was there before him, if he had but looked for it. In making these remarks the writer would be very unwilling to wound the feelings of any one, and still more to appear to set himself up as a master of the art of location; but he has used this line because an actual instance is so much more convincing and effective than an imaginary case, and if the facts be questioned, he can only add that he is at all times ready to substantiate them by running the line without money or price, solely for the satisfaction of testing the correctness of his own judgment and seeing exactly what may be done. He hopes at least that—if he chance to have an attentive reader among the younger members of the profession—he has convinced him that something more is required of a good locating engineer than the ability to run in a curve and fit it nicely to the ground. This is a rare and valuable accomplishment, but in comparison with the value of a skillfully adjusted *system* of gradients, it does not much matter whether the minor details are skillfully adjusted or not.

† There exists no apparent reason, on the present profile, why coal engines should be run any further than the Attica Summit, inasmuch as the empty coal cars might be hauled back to Attica by the regular freight trains over the 37 feet maximum shown, without limitation of the load which the same engine can haul over the 48 feet gradients from Attica eastward; but we have not assumed this to be done, partly because we believe the coal traffic is not so managed at present, and partly because our design is merely to illustrate a principle, and it is a purely fortuitous accident and not the result of design if the gradients are so arranged at present, inasmuch as such gradients within the maximum limits were evidently used as came most convenient. We have felt that in assuming the present line to be improved as above, we were making sufficient concessions for a fair comparison.

Continuous Trusses.

TO THE EDITOR OF THE RAILROAD GAZETTE:

About two hundred and fifty years ago Sir Thomas Browne wrote: "Of those three great inventions in Germany, there are two (gunpowder and printing) which are not without their incommodities. It is not a melancholy *utinam* of my own, but the desires of better heads, that there were a general synod; * * * for the benefit of learning, to reduce it as it lay at first, in a few and solid authors; and to condemn to the fire those swarms and millions of rhapsodies begotten only to distract and abuse the weaker judgments of scholars, and to maintain the trade and mystery of typographers."

And yet among the "incommodities" of printing when the good old physician wrote, there was no continuous girder literature to distract the scholar and fill his soul with forebodings as dreadful as those of Malthus and Hawksley. Fortunately, the chief part of this literature is locked up in foreign languages, and the few sporadic attempts to cultivate a taste for it or an admiration for its authors, in this country, have not been alarmingly successful. Still they are not without entertainment and altogether dry. One generous advocate of the fireside system of bridge-building, with all the excusable enthusiasm of the sophomore, has given us a profoundly interesting and curious compilation. In it we have a catalogue of German and French authors, with notes critical and explanatory, a discussion on the claims of Newton and Leibnitz, a short cut to that most valuable of all engineering studies, the calculus; how to run a line through any imaginary point, sage advice to engineers, and sundry other topics, all so simply expressed that, as he says, you can write them on the back of your hand. This is told not only as the dilettante alone can tell it, but with the most bewitching modesty and statical gravity. I grieve to find a fault or appear captious, but if (I am indebted to Britton on the Dry Rot, a kindred topic, for the suggestion) there was only a receipt for killing rats in it the usefulness of the work might be enhanced. And, as though it were necessary to add weight to his dicta on continuity, he recommends to us for single spans the Pauli system, a double bow, for the following most excellent reason: "The load is distributed along the neutral axis, thus securing the maximum of rigidity; while the neutral axis itself passes through the points of support."

The arguments pro and con continuous trusses in the discussion which has recently taken place in the pages of *Van Nostrand's Magazine*, between Messrs. Bender and Merriman, have been able and exhaustive. The case has been well presented on either side, by the former from the American or practical standpoint, by the latter the view that is taken by professors, chiefly foreign.

Mr. Bender has an advantage in a controversy of this character aside from his ability as an engineer; his education abroad has made him thoroughly conversant with German and French teachings and modes of construction, while several years' practice in this country and a conscientious and careful study of the American system has converted him from a strong advocate of continuity and made him an authority in these matters. On the other hand, Mr. Merriman is undoubtedly the ablest of his party, and what particularly marks him among them is the unusually clear manner in which he explains an abstruse subject. Being purely theoretical, his side is a difficult one to maintain against the conviction of American engineers. I say theoretical because European practice is so different from ours that we rarely look abroad for precedent in bridge building; and when we have done so the result has not been such as to induce us to repeat the experiment. In reality, so far as we are concerned, continuous trusses are untried.

The very foundations of Mr. Merriman's arguments are hypotheses, which are not only doubtful but which are strongly disputed. "Nevertheless," he says, "they are universally regarded by all writers as sufficiently accurate to form a basis of a working theory." Here is just the trouble: the writers are satisfied, but the workers are not; and the former remain satisfied until they come into practice and competition with other forms, when they generally let the theory find something else to defend it and for themselves take something practically better.

Mr. Bender, without by any means exhausting the authorities, has satisfactorily shown that the modulus of elasticity is not a constant; this destroys one of the illusions, called hypotheses. The elastic curve upon which so much depends in this discussion is, to put it very mildly, simply "a delusion and a snare." It is based upon rude and arbitrary hypotheses, ignores actual conditions, and is really only an ingenious method of getting some new problems for the entertainment of mathe-

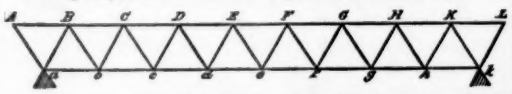
maticians. As Mr. Bender says, there is generally too great a readiness on the part of engineers to admit the results of tedious and complex mathematical performances; hence, the proficients in these things (I am not at all referring to Mr. Merriman) are not slow to take advantage of this disposition to exalt themselves, as they hope, and to condescendingly patronize us. The fact is, there is not a question connected with strains, no matter from what cause, in any kind of truss, continuous, upright arched, downright arched or any other, that cannot be more accurately solved without than with the calculus; and the reader may rest assured that when it is used in such cases, as it is apt to be for the cause given, it is sure to be based upon assumptions, chief among which are his credulity and ignorance.

Mr. Merriman has, by a simple remark, thrown a flood of light upon one point which has for a long time troubled practical men. We now know why the weight applied transversely to a beam produces effects disagreeing with the formula, why certain loads will or will not cripple columns with what seemed to be the greatest disrespect and irreverence to Gordon and Rankine; now we understood why the theorist will compel a bar to carry over 60,000 pounds to the square inch, while the bridge builder fails to persuade it to hold up much over 50,000 pounds; and now it is perfectly clear why, if we cut from a wide plate of wrought iron three strips, one from either side and one from the centre and carefully test them, we shall most generally get for each a different modulus of elasticity, and the average of the two outside pieces will not agree with that of the centre. The sunshine that illumines the blind gropings is simply "the incompetency of practical men to draw conclusions from even simple experiment." If the poor fellows only could, this unfortunate state of irreconciliation would not exist. Why does not some one at once dispel the illusion that prevails in some quarters on account of the confusion in the meaning of the phrase "civil engineering," that the practical engineer and the professorial engineer belong to the same profession?

On page 39 of his work on Continuous Bridges (Van Nostrand's Science Series, No. 25) Mr. Merriman makes a comparison between the third span of a continuous truss of seven spans, uniformly loaded, and a truss free at the ends of similar length, depth, load and manner of bracing, and finds that the sum of the strains in the different members of the former amounts to 87,570 pounds and in the latter to 140,195 pounds, and says: "For this particular span, then, a saving in material of 37½ per cent. is effected by using a continuous truss instead of a common one."

This result is most flatly contradicted by Mr. Bender's arguments; but this is not the point at which I am aiming. It is, that Mr. Merriman must know that he is not making a fair comparison; that this is not the case which produces the maximum strains in a continuous truss; and, further, when he gives the maximum strains he is not so ready with a comparison.

Let attention here be called to one thing: On page 123, same work, the author says that further experiments are much needed to confirm Woehler's conclusions that members which are subject to two kinds of strains must be proportioned to resist the maximum tension plus the maximum compression, and adds, "if confirmed, the pieces must be so proportioned and hence the percentage of saving lowered." Now, since Woehler's experiments were conducted for a space of over twelve years, with the greatest care, and were fully confirmed by Spangenburg, have never been disputed, and no doubt thrown upon them by other experiments, the question arises, why is there any hesitation in accepting them, when other experiments, unconfirmed and very generally disputed, on elasticity, are adopted and defended so strongly. The only answer can be, that if Woehler is right, as he undoubtedly is, or if the modulus be inconsistent, as it undoubtedly is, all the claimed theoretical advantages of continuous trusses, elastic curves and all, are disposed of at once and forever. Is not this conduct too much like taking the part of an advocate and summoning only such witnesses as help his side of the case?



The above is fig. 10, page 90, of Mr. Merriman's book, the third of five continuous spans; the length of this span is 80 feet; the depth, 10 feet; the live load, 64 tons; the dead load, 48 tons.

The maximum chord strains are given by the author, pages 106 and 107, as follows:

Upper Chord.		*Lower Chord.*	
A B + 104.0 tons.		*a b* — 76.9 tons.	
B C + 54.7 "		*b c* — 41.4 "	
C D + 36.1 "	or — 24.7 tons.	*c d* — 34.7 "	or + 34.6 tons.
D E + 33.2 "	" — 44.9 "	*d e* — 34.7 "	" + 47.8 "
E F + 36.1 "	" — 41.1 "	*e f* — 40.7 "	" + 47.1 "
F G + 45.0 "	" — 43.3 "	*f g* — 51.9 "	" + 34 "
G H + 60.2 "	" — 21.4 "	*g h* — 70.7 "	
H K + 86.0 "		*h k* — 127.9 "	
K L + 140.3 "			

The strains marked + are tensile, those marked — are compressive. As some members are subject alternately to each strain, it is seen that Woehler's results apply here. Adding the strains in the upper chord, we have as the sum 771, and in the lower, 642.4.

Now, make the comparison that is not made in the book, with the same truss free at the ends. Then the chord strains will be:

Upper Chord.		*Lower Chord.*	
B C — 49 tons.		*a b* + 24.5 tons.	
C D — 84 "		*b c* + 66.5 "	
D E — 105 "		*c d* + 94.5 "	
E F — 112 "		*d e* + 108.5 "	
F G — 105 "		*e f* + 108.5 "	
G H — 84 "		*f g* + 94.5 "	
H K — 49 "		*g h* + 66.5 "	
		h k + 24.5 "	

Here the sum of the strains in the upper chord is 588, and in the lower chord the same amount, or a total in the free truss of 1,176, against 1,413.4 in the continuous arrangement; or continuity here entails a loss of 20 per cent. in the chords alone. Suppose a truss of a uniform section sufficient to resist the maximum strain in a free truss, which in the case above is 112 tons, be continuous over the pier, where the strain is sometimes 140.3 tons, and then suppose the same beam cut in two over each support; there "would, I think, be little question as to which is the stiffest and strongest."

Mr. Bender has stated that a number of Long's wooden continuous trusses were built in this country, but he omitted to mention the fact that many of them soon showed signs of weakness and giving way over the piers; that they were therefore severed at these points of maximum strain, and subsequently lived in good health the usual number of years allotted to wooden bridges.

I would say that Mr. Bender had effectually disposed of the subject, had I not met, a few days since, a bridge-builder who has become a convert to continuity, and who told me that he intended, upon the first opportunity, to offer plans and bids for a continuous structure. "There is a great saving in it," said he. "You merely reduce your chord sections 30 per cent. and join your chords over the piers; you could reduce them 50 per cent., but I do not think it advisable; as for the braces, I don't alter them; the factor of safety keeps them all right." This is an actual fact.

I close as I began, with the good Sir Thomas: "There are a bundle of curiosities in philosophy, proposed and discussed by men of most supposed abilities, which indeed are not worthy our vacant hours, much less our serious studies; pieces only fit to be placed in Pantagruel's library, are bound up with Tartaretus *de modo cacandi*."

P. WINKLE, C. E.

THE UNITED STATES INTERNATIONAL EXHIBITION.

XXI.

MISCELLANEOUS.

A. BORSIG, of Berlin and Borsigwerk.—There was no portion of the Exhibition which deserved more careful examination by mechanical engineers—and none perhaps which was more neglected—than the exhibition of hydraulic forgings in the German department. We have already referred to the specimens shown by Krupp, but a much greater variety was exhibited by A. Borsig. These consisted of cross-heads for locomotives with two guide-bars, one above the cross-head and the other below; axle boxes, pistons; sections of wrought-iron wheels with crank-pin boss and the adjoining spokes, and others with the counterweights; outside cranks such as are very extensively used in Germany, the crank and the crank-pin being forged in one piece. Several specimens of very heavy cranks were shown, not only with the crank-pins forged solid, but with two eccentrics inside of the crank forged on the boss. These are intended for engines which have the valve gear outside the wheels—a plan still much used in Europe. These remarkable forgings were all made under a Haswell hydraulic press, a system of forging which is almost unknown in this country. For this reason and also on account of the perfection of the forging of objects of complicated forms, the following description of the process and machinery employed, given in a paper read by Mr. J. O. Butler before the Leeds meeting of the Iron and Steel Institute, will be of interest to our readers:

"The pressing of iron into a mould, or matrix, to give shape to various articles by the aid of the screw press, has been practiced for many years; the steam hammer has likewise been brought into requisition for the same purpose, but to a limited extent only. Reciprocating blows from a steam hammer, it is found, do not produce or accomplish satisfactorily the kind of pressure necessary for forcing the atoms or molecules of iron, in an incandescent state, into all the interstices of a mould where intricacy and accuracy are desired. This, however, can be done effectually by the inexorable thrust of a hydraulic or hydrostatic 'squeeze.' And this leads us to the subject of the paper now before you.

"We believe that Mr. Haswell, of Vienna, was the first to bring into practical and useful operation the 'squeeze' of malleable iron at a welding heat into shape and uses, as they are technically called, previous to their being manipulated by the smith and fitter. Some years before Mr. Haswell's patent of the machine, or tool, now under consideration was designed, hydraulic power had been made use of for forging or pressing malleable iron, both with and without the aid of an accumulator; but it is to Mr. Haswell that we are indebted for the improvements which make the hydraulic press a tool of general use. * * It is simply the adaptation of the hydraulic press, on the principle of Bramah, with an arrangement peculiar to Haswell, whereby a 'squeeze' can be given, either reciprocating or in one continuous thrust, until the piece operated upon acquires the desired shape. The pieces on the table are samples of what are produced: No. 1 is a sector of a 12-spoked wrought-iron locomotive wheel, showing three spokes with their portion of rim and boss pressed out of the solid slab. No. 2, locomotive cross-head ditto. No. 3, ditto (double), ditto, ditto. No. 4, outside crank with its pin, ditto. No. 5, piston-rod socket, ditto. No. 6, locomotive axle box, ditto.

DESCRIPTION OF THE MACHINE.

"The pumps are worked by a horizontal direct-acting steam cylinder, of large size, the working of which is directed by an automatical arrangement, so that it is perfectly and instantaneously under the control of the driver. The press consists mainly of two vertical cylinders of different sizes. These cylinders are fixed to a large cast-iron frame of cruciform shape, and may be termed the pressing and lifting cylinders respectively, the one below and the other above. The frame is supported on four malleable-iron columns or pillars, which are firmly secured to a bed-plate of a corresponding shape to the frame above. The two pistons or rams have cross-heads fitted on their outer ends, connected at their extremities by two strong malleable-iron side rods, so that the pistons or rams work simultaneously. Those rods, passing through grooves formed in the upper frame, and the intermediate steadying frame, act likewise as guides to prevent the rams turning. The hammer, or upper mould, or matrix, is, of course, fixed or fitted to the lower end of the pressing ram, and the bottom anvil, or mould, or matrix, is firmly bedded to the bottom bed-plate.

"The main steam cylinder is fixed horizontally on a strong bed-plate, the piston rod passing through packed stuffing-boxes at both ends, to which are attached, in the same line and plane, the rams of the respective hydraulic pumps. A small steam cylinder is placed by the side of the main steam cylinder to work its slide valve. Attached to the valve rod of this small steam cylinder by a lever is a tappet rod, which is worked automatically by a projecting arm attached to the cross-head of the ram of the pump, this acting upon the slide valve of the small cylinder, which in its turn actuates the slide valve of the main cylinder which works the pumps. The discharge branches of the two pumps are connected by pipes with the passages and chambers. The inlet and discharge regulating valves are worked by strong levers, having rods attached to their free ends, and directly connected with the piston rods of the two small auxiliary steam cylinders. The slide valves of these auxiliary cylinders are respectivly worked and controlled by means of the hand levers. The small cylinders, and which we may term cushion cylinders, are charged with oil, and have perforated pistons, the rods of which are also connected to the regulating valve levers before named. These cylinders act as cataracts or buffers to relieve the sudden 'chuck' incident to the work put upon the levers. There is also a loaded safety valve placed in a convenient position on the pressure pipe for relief in case of need.

"The press may be worked at any desired pressure, regulated by the boiler steam pressure, and either a light or heavy blow or squeeze can be given to suit the work in hand. The velocity and number of strokes per minute depends upon the efficient action and rapidity with which the two auxiliary cylinders can be worked, as these regulate the inlet and escape valves, the driver having merely to handle the levers of the slide valves. It will be perceived that no expensive foundations are required, as both the engine and press are self-contained."

In discussing this subject at the meeting at which the paper was read from which the above extract was made, Mr. Carbutt said "he had seen Mr. Haswell's machine at work in Vienna, and had come to the conclusion that it was the right way to do work. The only objection he saw to it were the dies, which were expensive, and which absorbed the heat from the metal and made it cold; but if the press were only heavy enough and strong enough to do its work, he believed the difficulty of the dies would be overcome."

Mr Paget said: "Having been enabled, for several years, to study at Vienna Mr. Haswell's processes, and having lately examined Mr. William Seller's work of a similar kind at Philadelphia, as also at Herr Borsig's works at Berlin, I may, perhaps, be allowed to say a few words. Strictly speaking, it is not forging that is done in this way, but rather swaging. The dead pressure of the hydraulic press allows cast-iron swages or moulds to be used of sizes that would be broken up by the percussive action of the steam hammer. The Haswell press merely does for larger forgings what the drop hammer—so largely used for the details of small arms and sewing machines—does for small forgings. The slabs are always more or less hammered before being put into the moulds. Similarly, as with swages and all special tools, it can only be used to pecuniary advantage for work in which there is repetition. In such uses the saving is very great, amounting for such uses as locomotive cranks to fifty, and even more, per cent., as compared with forging under the hammer. The most efficient way of using the Haswell press would be to set it up in connection with puddling furnaces. Beginning at the presses of Mr. Haswell at Vienna, at Herr Borsig's in Berlin, Krupp's at Essen, Baron Dietrich's of Niederbronn, Mr. Haswell's plan had been carried out and developed during the last fifteen years, realizing large profits and turning out such work as that shown before the meeting."

We do not know that the process of hydraulic forging has been applied by Mr. Sellers to any other purpose than the manufacture of eye-bars for bridges, but the German exhibit has shown that there is an industry which has reached a high degree of perfection in Europe for which there is a broad field here in which it needs to be introduced.

Besides the hydraulic forgings, the Borsig Works exhibited some beautiful specimens of locomotive connecting-rods in the forged state. These were made, like nearly all European locomotive connecting-rods, with solid ends, or rather solid straps and oil-boxes forged on the rod. A locomotive axle 7¼ in. diameter bent double; a front plate for a locomotive fire-box flanged made of steel ⅜ in. thick; another of wrought iron ⅝ in. thick; one boiler head 86⅛ in. diameter and ⅝ in. thick; one iron boiler plate 26 ft. 3 in. long × 82⅛ in. in width and ⅛ in. thick and weighing 3,740 lbs.; a plate for a locomotive frame, such as is used in Europe, for these axles 1⅞ in. thick. The jaws and other parts of this plate were cut out, but another solid plate was exhibited 24½ ft. long × 3 ft. 10 in. wide and 1¼ in. thick which weighed 6,000 lbs.

This exhibit was among the most noteworthy at the Centennial, and one which, it is to be hoped, will lead to the more general introduction into this country of the system of hydraulic forging.

LUXEMBURG MINING AND SAARBRUCKEN IRON SMELTING CO., Burbach. This company exhibited specimens of channel bars and I beams from 20 in. down to 7 in. deep and 15 metres = 49.2 feet long, specimens of deck and Z beams, and a top chord 15 metres long and of the section shown in fig. 1. They also exhibited a case containing specimens of a great variety of shapes, and a short section of a wrought-iron cross-tie shown in section in fig. 2 with the rail attached, iron-ores, coals, etc.

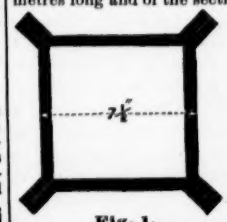


Fig. 1.

Fig. 2.

CARNOZZI & SCHLOSSER, Frankfort-on-Main, exhibited what they called a "railroad revising instrument," intended to show the condition of a track. It consisted of a four-wheeled truck with wheels 10⅛ in. diameter and spread two feet apart. A pendulum with an indicator attached showed the surface of the track, and one of the wheels was loose and had considerable end play on the axle. A spiral spring was arranged on the axle so as to press the flange of the wheel against the rail. An indicator was arranged in connection with the wheel, which thus showed the gauge of the track.

GLOECKNER BROTHERS, of Tschirndorf, Silesia, exhibited specimens of cast-iron brake shoes with chilled surfaces, an article, we believe, that has thus far not been manufactured in this country.

RAILROAD GAZETTE

Published Every Friday.
CONDUCTED BY
S. WRIGHT DUNNING AND M. N. FORNEY.

CONTENTS:

Editorial Announcements.

Passes.—*All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.*

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

THE YEAR.

The year 1876 began when the country and the railroads had suffered for three years and a quarter the effects of the collapse of September, 1873. Then a season of great activity in nearly all kinds of business,—of increasing production and high prices—suddenly came to an end, and a process of newly adjusting the productive forces of the country (and largely of the world) began. So far as railroads are concerned, the change in conditions was great, the old ones having been probably quite as abnormal as the new ones. Under the old order of things there was such growth in production that the old railroads found their traffic increasing constantly and at a rapid rate. The only safe policy was to increase the capacity of the road yearly in anticipation of the increase of traffic which, as indicated by years of experience, was sure to come. Meanwhile there was enormous activity in the construction of new railroads, which absorbed a large part of the savings of Europe as well as America, and multiplied routes in districts which were already well supplied with transportation, as well as in other territories where traffic was yet to be developed. This multiplication of lines had been going on for some years; but comparatively few of the new lines had as yet developed traffic enough to effect the business of the older roads materially. A very large proportion of them were not fairly completed and in the field as competitors until 1873.

Before that year for some time the securing of a few millions of dollars for a new railroad was one of the easiest of tasks; and any community which wanted a railroad had comparatively little difficulty in getting it. Lines were laid out parallel with and branching from old and solvent railroads, and the new line was sure to take some part, often a considerable part, of the local traffic formerly received at the stations of the old railroad. Projectors of these lines would connect them with one line or its competitor according to the terms offered. The consequence was that a very large proportion of the solvent roads bought or leased or guaranteed the bonds of new lines which could little more than bring them by rail a traffic which previously they had received by wagons. That is, capital accounts had been largely increased previous to 1874 for additional lines which added little to the earnings and still less to the profits, besides the increase for adding to the capacity of the old lines to meet the growth of traffic, which was none the less imperative—often more so—when the new branches were acquired.

At the same time wages and materials were very high, and on the whole were tending upward until 1873, $90 for iron and $120 for steel rails being charged about the close of 1872. Rates tended downward, but usually the increase in traffic counterbalanced that effect. It was, in short, a season of expansion and high prices.

When the panic came there was a collapse in many industries which greatly reduced some kinds of traffic, or, what was equivalent in effect, prevented the large increase which had been expected and provided for. The depression in business also compelled reductions in rates, which were further caused in many districts by the completion of the many thousands of miles of new railroad just fairly at work, which for the most part were in desperate straits for business enough to keep them out of bankruptcy.

Thus when the panic came, and a reduction of traffic or an arrest in its growth thereafter, it found the railroads, the old and profitable ones, we mean, burdened with larger fixed charges for interest than ever before, and exposed to unusual competition. Their whole management had been based on a different rate of receipt from that which has prevailed since, and the calculations were for a larger traffic than they have got. The expenses were altogether out of proportion to the earnings, and though the same collapse which affected their rates brought down most other prices, still the reduction was in many things slow. And, indeed, in the nature of things, general reductions in prices are progressive. The fall in one material or class of labor reduces the cost of some other material and the living expenses of another class of workmen, permitting further reductions, and so on. Thus, though great reductions in prices of labor and materials were made within the first year after the great September failures, the process did not cease then, but has continued down to the close of this year; and probably the reductions of this year have caused less suffering than the earlier ones, because they were largely the consequence of reduced expenses. When coal went down a dollar and a half a ton, the cost of producing iron with that coal became something like three dollars a ton less, and if the price of the iron fell two dollars a ton, it did not indicate a corresponding injury to the business of iron manufacturing. The New York merchant who pays now $2,000 a year rent for the house which formerly cost him $3,000, and has most of his other expenses reduced, may not suffer at all though his income is largely reduced. The fact is, money is worth more than it was a few years ago—gold as well as currency; a dollar buys more, so that a comparison of prices in 1872 and 1876 is something like a comparison of gold prices in Europe with currency prices in America when gold is at a high premium.

When the panic came, then, and receipts suddenly fell off, while the yearly charges for interest were increased, a frantic effort at economy was made, and it took the form chiefly of large reductions in wages, and the postponement of such repairs as could be put off without great injury to the roads and their equipment. The reductions in prices of materials came of themselves as a natural consequence of the almost total arrest in railroad construction and the economy of the roads in operation. The starving process cannot last very long without disaster, but it has doubtless been kept up on some roads down to the present time in some particulars, such as station buildings, which have been permitted to become dilapidated, and sometimes in rolling stock, when there was a full equipment to begin with not always needed for the traffic. Doubtless an accurate estimate would show on more than one road that the equipment is much less efficient now than in 1873, and it is sometimes absolutely less in quantity. But generally the starving process, where it was resorted to at first, came to an end before 1876; and during this year and for some time previously the chief energies of managers were directed to contriving and enforcing economies in methods, a work which has been perhaps the most fruitful that was ever undertaken by railroad men, though the whole effect of it will never be generally known; for so far as railroad proprietors are concerned, the savings have not given them increased profits, but have saved them from ruin—a service for which they are much less grateful, because they rarely knew that ruin was impending.

The business of 1876, so far as its volume is concerned, was generally not unsatisfactory. There was a heavy grain traffic (the heaviest on record), a heavy cotton traffic, a large movement in live stock and provisions, a decrease in the great anthracite coal movement, but so far as appears, not much in the more extended bituminous coal movement; the lumber traffic, which forms the great bulk of the westbound traffic of Northwestern roads, has been considerably reduced; and in most manufactures and merchandise traffic has been unsatisfactory, though on the whole, perhaps greater in amount than the previous year: there are no statistics to show this. As to earnings, not enough reports are published to indicate what they have been in the aggregate, with anything like certainty. The trunk lines that have reported show a considerable decrease, but they have been in an exceptional position. For the eleven months ending with November we have reports this week from 24 roads with about one-sixth of the total mileage in operation in the country. These show an aggregate increase of earnings of 6.2 per cent., and of 3.9 per cent. per mile of road. As almost everywhere expenses have been reduced, this is a favorable result compared with 1875. But the latter was an unfavorable year, with a terrible winter which increased expenses. By a table which we published on page 268 of the current volume, it appeared that 64 railroads in 1875, with 27½ per cent. of the total mileage worked that year, earned gross 5 per cent. less and netted 6¾ per cent. less than in 1874, and the net earnings per mile of road fell off 9 per cent. Considerable improvement was needed, therefore, to make anything like a satisfactory result this year.

The greatest change in the financial condition of railroads during the year is that of the carriers of anthracite coal, which was not caused directly by the decrease in the traffic, although that is considerable, nor by a fall in the rates for transportation, which did not take place till September, but chiefly by a fall in the price of coal, for these railroad companies are miners and mine-owners as well as carriers; they have spent many millions for coal lands, borrowing the money, and when the "combination" broke at the end of August, and prices fell about 40 per cent., apparently no margin of profit was left for the mine-owner. Their position, therefore, is not that of the ordinary railroad company, which depends solely on transportation business for its income. The fall in the market price of the securities of the coal companies amounts to an enormous sum—that in the stocks and a very small part of the bonds amounting to $60,000,000. None have failed to pay interest on their bonds as yet, but nearly all have ceased to pay dividends on their enormous stock capital.

A few companies have been added to the list of those in default, and a few which failed previously and made an arrangement with their creditors have not been able to resume as they promised. Not many companies, except the coal carriers, which paid dividends in 1875 have passed in 1876, but quite a number have reduced the rate somewhat, and on the whole something less has been divided among railroad proprietors—bond and stockholders together—than in 1875.

Considerable progress has been made in settling the affairs of the roads in default by foreclosure sales, which have been very numerous, the process of arriving at a sale being rather slow. A vast number of roads are still in the hands of receivers, but there will be numerous foreclosures the next year, which will relieve some of them of their charge.

In railroad construction there has been satisfactory activity. We have information down to this time of 2,278 miles of new road in 1876, against 1,333 miles at the same time in 1875 and 1,844 in 1874. This is a small mileage, compared with the 3,600 reported in 1873 and the 7,200 in 1872, but is as much as we ought to build, we believe. It adds 3 per cent. to the mileage of the country, which is more than the increase in population and production, probably. The Southern Pacific and the Cincinnati Southern are the longest lines of the year; most of the new roads are short and intended almost wholly for local traffic and built largely by those who expect to profit by their operation.

We were about to say that the year had been distinguished by a railroad war between the trunk lines of unexampled duration and severity; but we said that a year ago of 1875, and in fact that year is distinguished when there is no railroad war between the trunk lines. It is true, nevertheless, that rates were never so low on through traffic between the Atlantic seaports and the West, and excessively low rates never lasted so long. From April 22 to Dec. 18 the common rate from Chicago to New York, 912 miles by the shortest route, was 20 cents per hundred, or 0.44 cent. per ton per mile, and most of the time the rate was still lower on west-bound freight. The cause of the contest was the diversion to Baltimore and Philadelphia of a large grain traffic which formerly went to New York. We publish to-day the agreement by which the contest terminated, which is, that for freight exported the rate shall be the same by all the ports Philadelphia and Baltimore have gained largely in grain receipts during the year, while New York has lost, one of the chief causes of which, doubtless, was that the rail rates were as low as the water rates, so that it was as cheap in the summer as well as in the winter to ship to Philadelphia and Baltimore, which is not the case when, as usual, the lake and water rate is considerably lower than the rail rate.

The competition has extended to passenger business, and the low passenger rates still continue. Besides the reduction on through passengers by the trunk lines, there were "Centennial rates" for half the year for the traffic to and from Philadelphia, which stimulated traffic enormously on a few roads, and considerably on many; though but few had

much increase of passenger earnings on that account.

In railroad legislation there has been little new to chronicle. The bitter feeling towards railroad companies which was so prominent a few years ago has almost disappeared, and there is a more general tendency to recognize the right of a railroad to earn interest on its cost—if it can.

The year closes with the roads, as a whole, better prepared for their conditions probably than ever before since the panic. Their managers have learned, or are learning, how to do their work cheaply; they have ceased to expect a sudden revulsion in the course of things which will restore the flush times previous to 1873; they expect, generally, a slow growth in the amount of traffic, and low rates for carrying it, and will be satisfied with a small increase of earnings and will not be satisfied without some diminution of expenses. If they will keep the peace, they have a fair prospect ahead.

RAILROAD COMPANIES AS MANUFACTURERS.

The question whether railroad companies can manufacture rolling stock and other equipment profitably is one which has been much discussed but, so far as we know, has not been very carefully investigated. Some rather difficult questions are involved in it, to answer which we need certain facts and data which ordinarily are not procurable excepting from records and accounts of railroads which are seldom made public. There can be no doubt, however, that very vague notions exist among some railroad officers regarding the cost of manufacturing, and that if their ideas were applied to the management of any ordinary manufacturing establishment, it would result in speedy bankruptcy.

There probably are circumstances under which a railroad company can manufacture some portion of its equipment to advantage, but there are also doubtless many cases in which the cost of articles is greater if made by railroads in their own shops than it would be if bought of manufacturers. In one case which came under the notice of the writer, a railroad company built some new engines and also determined to make the bells for them in its brass-foundry. No one about the establishment knew anything about the manufacture of bells, so that in making the first pattern the form was very unlike that which a bell should have in order to give out a good sound. The first pattern and the first bell were therefore failures. A second pattern was therefore made and was copied from the most "high-toned" bell on the road. But unfortunately the brass-founder knew nothing of the proper mixture of metals necessary to give "tone" to a bell, so that a number of experiments were again made and in the end one was produced which had very much the sound of a tin pan and was not nearly so good as could have been bought of an experienced bell-founder for a fair price. It is not known whether the cost of the bells made by the railroad company was ever made up or not, but it would have included such items as the following:

Time of draftsman making drawing	$....
Cost of first pattern	$....
" " casting first bell	$....
Time of draftsman making second drawing	$....
Cost of making second pattern	$....
Cost of making three or four or more castings	$....
Waste of metal in do	$....
Cost of finishing bell	$....

How many etc., etc., should be added it is now impossible to know. This of course is an extreme case of this kind, but it illustrates very clearly the causes which may make the work done by railroad companies very much more expensive than it would be if done by persons whose entire time has been devoted to one special kind of production. The worst feature, however, is that in all probability no one ever knew how much our illustrative bells ultimately cost. Probably the draftsman's time was charged to general expense, the cost of patterns to some other general account, while the only charge made in the brass foundry was for the weight of the bells at the regular price per pound for brass castings, so that the cost at which the bell was represented on the books was entirely false and would only serve to mislead those who examined it. Exactly similar causes, however, are certain to increase the cost of locomotives, cars, wheels, frogs, switches, etc. Even with the most skilful management in designing work there will always be errors and oversights, dependent of course on the amount of experience and foresight of those in charge of such work, and therefore it is natural to suppose that those whose time has been exclusively employed in one given branch of manufacture will commit fewer errors than those who are not exclusively engaged in one occupation.

Every manufacturer, too, knows how large a proportion of the cost of production is due to what is ordinarily called "general expense." Nearly or quite a fourth of the cost of operating a railroad may be classed under this head. A leading manufacturer of locomotives said to the writer that when business was good 20 per cent. should be added to the cost of engine in order to cover "general expenses," and in dull times very much more, and in another establishment 10 per cent. of the cost of tools and machinery was annually charged to expense account. Now it is very doubtful indeed whether in making up the cost of equipment manufactured in railroad shops, all those sources of cost are charged up, so that the final cost is very apt to be to some extent fictitious and misleading.

A recent number of the *Engineer* contains a letter from a correspondent in which the latter says:

"At one of the Northwestern Railway meetings last year one of the shareholders put a question which indicated that he wanted to know more in detail how Mr. Webb achieved such marvellous results (that is, built locomotives for £1,800). In reply Mr. Moon said: 'With regard to the rolling stock, we calculate no charge beyond materials and wages, and there is nothing added for cost of shops, the interest on which is paid by the proprietors as we go along.'

"As a large proportion of the material is made at Crewe, such as boiler plates, tires, axles, castings, forgings, etc., and of course made 'without charging anything but material and wages,' it is easy to see how a cost is brought out which everybody with any practical experience knows to be preposterous. The effect on the company's accounts may be stated in a sentence: If the rolling stock is being made from capital, then general interest bears a proportion of the charge which ought to go to capital, and the shareholders are deprived to that extent of what ought to be paid to them in dividend; while, if made from revenue, the interest account is charged with what ought to go to swell the cost of engines, carriages, wagons, rails, etc. The system encourages shareholders to sanction large outlays of capital for buildings and machinery, under the erroneous idea that they will save the manufacturers' profits, and they thus burden themselves in perpetuity with a charge for interest which is to a large extent unnecessary.

"To such an extent has this been carried at Crewe, that it was publicly stated not long ago, that because the Northwestern Company were interdicted from supplying rolling stock to other lines, it had become necessary to work short time, thus throwing a lot of valuable plant idle."

As this correspondent presents it, and as is really the case, part of the cost of manufacturing is the interest on the cost of the tools, machinery, etc., employed, and also the amount of their deterioration. If one or more new locomotives were bought at say $9,000 a piece, so as to increase the equipment by that number, they should be charged to capital account, because the property owned by the company is increased by that amount. But if instead of buying them the company built them in their own shops, and charged only the cost of "labor and material," so that their cost would amount to only $7,200, and this amount were charged to capital account, then, obviously, the interest on cost of tools and machinery and their deterioration must be charged to "*interest*," or some other account; or, in other words, what should be paid to the stockholders in dividends becomes a credit to capital account. If the cost of engines is paid entirely from the revenue of the road, instead of being charged to capital, then the amount thus expended is taken from that which should be paid in dividends in order to keep the capital account down lower than it really is or should be.

One of the most serious evils, however, is, as this correspondent points out, that under the idea of saving the manufacturers' profit, large outlays of capital are made which thus becomes a burden *in perpetuity* on which interest must be paid. There are a number of railroad shops in the country now in which a large part of the tools and machinery are idle, but the interest account on which is not. If instead of erecting costly shops the companies had instead given their orders to private establishments, even at a greater cost, they would now be able to use the capital invested in superfluous shops where it would be productive instead of dead.

It must also be remembered that very much depends upon the manner in which money is invested in tools, machinery, etc., whether it will be productive. Hardly any kind of business must be conducted with so much knowledge, good judgment and foresight as that of a large manufacturing establishment. Unless the responsible person is directly interested in the results to be attained it is almost certain that a proportion of the investment will be wasted, either through ignorance or the want of that motive power or stimulus which we all need to make us think clearly. This condition of things is especially liable to occur under the organization of a railroad company, which is to a greater or less extent changeable in its character, with the responsibility divided among a number of persons, few or none of whom have more than a salaried interest in the result.

There is, however, another side—perhaps several—to this question. It is said by many railroad officers that it is true that a very considerable cost of manufacturing is properly chargeable to "general expense," but it must be remembered that that account is almost uniform, no matter whether the business done is large or small. In order to do the ordinary repairs to rolling stock and other equipment, it is necessary to have shops, tools, superintendence and all the paraphernalia of a manufacturing establishment, whether any new work is made or not. There must be a person in charge, a draftsman to design, foremen to superintend the men, an engine and man to run the machinery, watchmen, water and gas supply, and all the countless accessories which become so formidable in the aggregate, when charged up under the common head of "general expense." Besides, it will be said that the repair work on a road is of so varying a character that unless some new work is kept in progress it will be frequently necessary to increase and diminish the number of men, and thus break up and reorganize the working force. We are inclined to believe that an importance is often assigned to this argument which it does not deserve, and in most cases that it would be found to be much cheaper, in the long run, to increase the equipment somewhat, so that engines and cars which require thorough repairs would be allowed to lie over until the dull season for a general overhauling. There can be little doubt that the cost of the products of any manufacturing establishment will be diminished if it can be kept employed uniformly—that is, can work a full force of men and get the maximum amount of work out of what the English people call the "plant." In this way the amount of the general expense account is distributed over a larger aggregate and relatively is less than if it was all chargeable to a comparatively small sum. It is this principle, it is thought, which ought to determine whether a railroad company should undertake to manufacture any of its own equipment. The end to be aimed at is to have shops as small and with as few tools and as little superintendence as are needed to keep up the repairs for the road, and then keep the shops and the tools and men as constantly at work as possible, so as to produce with them the largest amount of value practicable. If, in order to do this, it is necessary during dull seasons to build some new work, possibly it may be done to advantage; but if a corporation, organized as a railroad company must be, or at any rate always is, enters the field to compete with private manufacturing firms and companies, it is quite certain to do so at a great disadvantage. To use a common phrase, the manufacturing firms "will beat them every time." The difficulty of investing large amounts of capital for manufacturing purposes profitably and of having money invested in that way in perpetuity is so great that the rule to be laid down by a railroad company, it would seem, should be, *not to invest capital or extend their works for the purpose of production of equipment, but only for its repair.* If the latter can be done more profitably by occasionally doing some new work in order to employ the tools and the men, it may be right to do so; but it should be kept in mind that *repairing and not manufacturing* is the business in which railroad shops should be employed.

One exception should perhaps be made to this general principle. There are certain kinds of materials, etc., used on railroads, such as oils, brass, etc., the quality of which it is almost impossible, or at least very difficult, to determine before using them. In such cases a railroad company is almost entirely at the mercy of the seller. In order therefore to be sure that it is getting a good article, it must make it itself. It is necessary at times to make this exception, owing to the dishonesty of average human nature. The same reason is given, too, for building railroad cars, because it is said to be impossible to have them made of good lumber unless the railroad company buys it and can thus control its quality.

Reports of the Erie Officers.

Besides the report to the State Engineer and Surveyor, of which we made a summary last week, the Receiver has issued one for the same period (the year ending with September last) addressed to the board of directors. This latter document contains a report from Mr. H. J. Jewett, the Receiver, giving explanations concerning the more important financial transactions of the year; one from Mr. E. S. Bowen, the General Superintendent, on the work of the year and the condition of road and equipment; a report from Mr. S. Little, the Auditor, giving in great detail the accounts of the company, in which the expenses are divided in a different way from that prescribed by the form for the report to the State, and comparisons are made with the previous year, thus making for practical purposes a new report for 1874–75, as no other report than that to the State Engineer and Surveyor had been made for that year previously. Mr. Little's report also gives a summary of receipts and expenditures during the year separate from that of earnings and expenses belonging properly to the year, which is important as showing precisely for what the Receiver has paid out money, for all purposes, and where he got it; this report contains further many deductions and comparisons, part of which we laboriously computed in our summary of the report.

The document closes with a report from the Chief Engineer, Mr. Octave Chanute, of estimates of the cost of the improvements which seem most desirable for the road—estimates which the proprietors will do well to consider; for extensive improvements *must* be made if the property is not to be permitted to become less and less valuable yearly.

It is unfortunate that our summary was not made from this report; but the best we can do now is to exhibit a few of the statements in the accounts and give the substance of what the different officers say.

Mr. Jewett, after making a general statement of the business of the year and the effect of low rates, explains that advances of $259,810 to the Hillside Coal & Iron Company and the Northwestern Mining & Exchange Company (coal companies whose stock is almost exclusively the property of the Erie) were necessary to protect the large investments made in these companies by the Erie previous to the receivership. He also says that an expenditure of $71,089, shown in the accounts, was to protect the company in the use of the National Stock Yards at Jersey City, which, owned by a distinct company, were thought to be managed in a way which injured the railroad company's live stock business. The Erie owned $232,300 of its $1,000,000 capital stock and $655,000 of an issue of $1,000,000 mortgage bonds. The expenditure named secured it $549,500 of the stock and $10,000 of the bonds, thus giving it absolute control. The yards are now leased for $65,000 to a com-

pany which guarantees that the Erie shall receive its proportion of the live stock delivered at the New York market.

A similar expenditure of $89,450 was made for stock of the Union Steamboat Company, which runs a line of propellers organized to run in connection with the Erie between Buffalo and the Upper Lakes. Of its $1,000,000 stock the Erie owned $869,000. The steamboat company had expended its net earnings for increasing its stock of steamboats, but the individual stockholders objected to this and demanded that these earnings should be divided or that the railroad company should buy their stock. The Erie bought 1,250 shares for the sum named (at the rate of $71.40 per share), and now owns the entire stock, there being 60 unissued shares.

A larger expenditure was $255,000 for bonds of the leased Buffalo, New York & Erie Railroad, which gives the Erie a connection with Buffalo from Corning. A mortgage had matured and foreclosure proceedings were begun, but by order of the Court the Receiver took up the bonds, thus securing for the company whatever rights had accrued to the bondholders, and it now holds those bonds.

Another investment was $50,000 for stock of the Suspension Bridge & Erie Junction Railroad, leased to the Erie, and connecting it with Suspension Bridge and the Canadian roads there. The rental was much above the earnings, guaranteeing the interest on the bonds and 7 per cent. on the stock of the leased road. The lease could have been abandoned, probably, under the receivership, but the line was valuable, and at a lower rental was desirable. The Erie paid $50,000 and secured $53,700 of stock, which, with $175,300 previously owned and some time since acquired in the settlement of accounts, gives it control of the company.

One of the company's burdensome contracts inherited from the Gould administration was that with the Jefferson Car Company, by which the Erie was to pay a cent a mile for the use of 1,500 four-wheeled coal cars, maintain them perfectly, and guarantee the earnings to be $84 a year each. The railroad company failed to pay at one time, and when suit was brought it maintained that the contract was void for some reason, but the car company obtained judgment for nearly $180,000. Then an agreement was made to purchase the cars, paying therefor and in satisfaction of the judgment $300,000 in cash and $278,400 in shares of the car company, which the Erie then owned, but which the Receiver says "was of no value independent of the cars owned."

The accounts show that $250,000 was expended on this account during the year.

Of all the above payments the Receiver says:

"The foregoing comprise the principal payments made on accounts other than those involved in the immediate management of the property of the company, its improvements, and the payment of its fixed liabilities. They were all made by the express authority of the Court, after a consideration of all the facts, and after such facts and the proposed action had been submitted to and approved by your board."

The floating debt has been reduced $974,621 since the appointment of the Receiver.

Referring to Chief Engineer Chanute's estimate of the cost of needed improvements, Mr. Jewett says that he thinks the estimates substantially correct, and adds:

"Even if the full amount of work proposed could not be done, if sufficient means could be provided for completing the double track, laying the third rail, increasing the equipment, and remedying the difficulties which exist in that at present in use, together with some of the proposed terminal facilities, the capacity of the road to earn at a largely reduced expense would be greatly increased, and it would probably be able out of its earnings, in addition to discharging its fixed obligations, to make the balance of the improvements required."

He concludes as follows:

"An effort is being made by a committee of the bond and shareholders in Europe to provide the amount required for these improvements, by a funding of a portion of the mortgage coupons, and by contributions from the shareholders.

"I cannot too strongly commend to the members of the board that they give their hearty co-operation to this, or some other mode for providing the means needed for these improvements. Their necessity, their importance, and the ability of the company to much more than provide for the interest upon the increased debt which such provision will involve, cannot be doubted by any one, especially if it be borne in mind that the actual cost of transferring the traffic now moving over the road from and to its connections, rendered necessary because of its exceptional gauge, would, of itself, be more than equal to the interest upon whatever debt it might be necessary to incur in the completion of the third rail.

"I beg to repeat that my faith in the value of the Erie road and property has not changed; but, on the contrary, my everyday experience strengthens the conviction that it needs only the succor and support of its owners to make it, in point of importance, of value, and of productiveness, equal to any of the trunk lines; and that if thus supported and completed, it will not only be able to promptly meet its fixed obligations, but would be equal to the payment of regular dividends upon a properly adjusted stock basis."

The report of Mr. Bowen, the General Superintendent, gives many of the facts contained in our summary of the report last year, with much concerning the road and equipment not heretofore published. It says that 9,464 tons of steel rails and 7,524 of re-rolled iron were used in repairs of track during the year. These would lay about 170 miles of track, which is 9¼ per cent. of the mileage worked by the company. At Mr. Jewett's accession in July, 1874, there were 176¼ miles of steel in the track; this has been increased since that time to 341 miles. Now 79 per cent. of the main line Eastern Division, 67 per cent of the Delaware Division, 10 per cent. of the Susquehanna Division, 1⅓ of the Western, and 49⅛ per cent. of the Buffalo Division are laid with steel. Since the use of steel began the quantity of rails used yearly in repairs has decreased rapidly, the tons for each of the past eight years having been:

Year.	Tons.	Year.	Tons.
1869	34,695	1873	25,744
1870	26,441	1874	13,858
1871	23,970	1875	19,070
1872	20,175	1876	16,988

Mr. Bowen reports the condition of the track to be about the same as at the date of the previous report, except so far as improved by the additional quantity of steel rails; the ballast, never sufficient in quantity or of approved quality, is much worn and needs renewal; about 9,400 tons of steel rails, 8,500 of re-rolled iron, and 550,000 cross-ties are needed for maintenance during the current year. With this amount of steel a continuous main track of steel could be made from Jersey City to Susquehanna, 191½ miles. Extensions of the double track over the six miles between Canisteo and Adrian, the six miles between Pine Grove and Narrowsburg, and the 5¼ miles between Stockport and Lordville, are much needed. Thirteen spans of iron bridge have been put in the place of wooden structures, and of 231 bridges of more than 20 feet span on the road, 58 are of iron and all the rest wood, some of which were rebuilt last in 1862. Forty-two are specified and described which need rebuilding in 1877.

There are not engine-houses enough to shelter all the locomotives, many of which stand out of doors; most of the engine-houses are of wood. Many station buildings need to be rebuilt.

The Bradford Branch has an increased oil traffic and now earns a little more than its expenses. Some improvements have been made in the North River docks of the company, and more are needed.

The company bought 20 first-class locomotives of the Brooks Locomotive Works during the year for $196,000 and built at its Susquehanna shops four new Mogul engines at a cost of about $44,000, and these are the only engines added to the stock in the revenue service since August, 1872, though several have been bought for switching, etc. During last year, while 24 new engines were acquired, 16 old ones were condemned and destroyed. Of the stock of engines Mr. Bowen says:

"Of the 469 locomotives owned by the company, 116 are inside-connected or crank engines, which are more expensive to keep in repair than the modern patterns. The locomotives embrace 83 different varieties, which fact, obviously, largely increases the expense of maintenance, requiring a corresponding amount of special patterns, tools and materials. Of the 45 locomotives on the Western Division, 36 are of the standard pattern, and the cost of repairs on that division shows 4.41 cents per mile run, while on the whole road, including that division, the cost was 7.05 cents per mile. This economy of repairs is obtained from the uniformity of the engines, and clearly proves the importance of adhering to the standard in all future additions."

And this of the freight cars:

"In the freight-car equipment are 230 varieties, many of them differing in their essential parts; as, for example, 19 different journal bearings, 53 journal boxes, 27 drawheads, and 52 brake shoes. This involves the necessity of carrying a large stock of material at the respective shops, and largely increases the cost of current repairs."

Mr. Bowen closes with the following reference to the great need of the company:

"I cannot neglect this opportunity to refer to the necessity that exists for some important modifications of the property of the company. You are struggling to compete for a common business with parallel lines of railways having double tracks of steel rails, an abundant equipment, adequate shops, and convenient depots for the transaction of their business; while you are limited by a single track on a large portion of your road, the shops inconvenient in arrangement and insufficient in capacity, many miles of iron rails that rapidly fail under the heavy traffic, and damage by their imperfections the rolling stock, which is in itself quite inadequate, when all of it is kept in the service. The exceptional gauge is also an element of constant cost, while it also largely tends to limit the amount of the revenue, by limiting the amount of property that will be entrusted to you for transportation while the possibility of transfer exists.

"Estimates of the cost of this undertaking have been prepared in detail from time to time, and while the amount of money required is large, it is confidently believed that the return from the investment will be more than ordinarily remunerative."

The Auditor's report, as we have said, is much more full and minute than is usual in railroad reports, and, we may add, presents the accounts with remarkable clearness and exactness. For the year, after paying the expenses chargeable to revenue, except $2,877,785 interest on bonds, there remains a balance of $1,648,155. All but about $50,000 of the unpaid interest is due in gold, so that the real deficit was greater than appears from the figures. The report separates coal earnings from the rest of the freight. These were $3,177,145.75 last year against $4,264,741.27 the year before, showing a loss of more than a million in this single article, or 25¼ per cent. Meanwhile there was an increase of 2.9 per cent. in the earnings from general freight. It also gives the tonnage mileage of coal, which was a little more than a third of that of "general freight" last year, against one-half that in 1874-75. The latter increased 14.3 per cent.; the former decreased 21.7 per cent. The report proves what we said last week, that the coal is the profitable traffic. The average receipt from this was about 1.20 cents per mile; that from all other freight, only 1.06 cents per mile. Assuming the expenses to be equal for both (and considering the costly terminal expenses for much of the other freight the coal certainly should be the cheapest to carry), the company's profits were 80 per cent. greater on coal than on the average of other freight; and while there was a profit of about $1,270,000 on the coal business, all the other freight business (nearly three times as great in volume) returned net but about $1,348,000.

The report gives the earnings and expenses per train mile as follows, earnings from mail and express being properly included in passenger train earnings:

	1875-76.	1874-75.	Decrease.	Per ct.
Passenger train:				
Earnings	$1.32	$1.36	$0.04	3.0
Expenses	0.94	0.94	0.00	0.0
Profit	0.38	0.42	0.04	9.5
Freight train:				
Earnings	1.52	1.62	0.10	6.2
Expenses	1.22	1.28	0.06	4.7
Profit	0.30	0.34	0.04	11.8

Our summary last week gives these figures for all traffic trains.

Not the least valuable part of the Auditor's report is the summary of the transactions of the year not shown in the revenue account—that is, receipts not accruing in the year and expenditures not chargeable to the year's business.

In this the debits consist chiefly of the surplus, accounts due and unpaid, claims recovered, and the advance of the Lehigh Valley Company for the third rail; the chief credits are the reduction of the floating debt ($423,995); construction (chiefly third rail, but amounting to $1,258,833 for main line and $32,256 for branches); an increase of $500,605 in accounts payable; the investment of $373,233 in the securities of other companies; and a reduction in the amount of miscellaneous liabilities. This account is given very fully, and will enable the stock and bondholders to know just what the resources of the company have been and how they have been used, which is more important in the case of a company like the Erie than in one in ordinary circumstances, perhaps. Mr. Little's final statement is, that the net revenue from the time of the appointment of the Receiver down to the end of September, 1875, was $27,551.80 in excess of all charges to it; adding the interest in default at that time, the sum becomes $1,025,493.38. Of this latter sum at the disposal of the Receiver, $550,626.79 went to reduce the floating debt, and $374,751.92 for charges incurred other than working expenses, and shown in detail in a following statement.

Mr. Chanute's estimates of the improvements needed on the road and their probable cost touches a vital question to the Erie proprietors.

We summarize it as follows:

Extending third rail to Jersey City	$2,100,096
Substituting steel for iron, 660 miles	1,320,000
Second tracks, and loop lines	4,535,000
Engine houses	295,000
Shops and tools	1,350,000
Stations and sidings	1,277,000
Renewing wooden bridges with iron	850,000
Bergen Tunnel	65,000
Transfer floats	50,000
Grain elevator	550,000
Merchandise warehouses, Jersey City	950,000
100 new locomotives	1,100,000
2,000 new freight cars	1,100,000
Total	$15,542,096

This closes a report fuller of information to Erie proprietors than any other that has been published of late years.

The Grain Movement for Thirty-four Weeks.

The returns for the week ending Dec. 16 show no shipments by lake whatever. We therefore discontinue the long table showing comparisons of shipments by lake and by rail, which was complete for the season of navigation last week. The total shipments from the eight principal Northwestern markets for the 34 weeks from April 23 to Dec. 16 have been:

Heretofore reported	67,428,425	55,548,001	122,976,426	45¼
Week ending Dec. 16		1,380,152	1,380,152	100
Total for 34 weeks	67,428,425	56,928,153	124,356.578	45¾

The rail shipments for the last week were almost the same as for the week previous, and, indeed, rail shipments have varied very little since October, though lake navigation was open for a month of that time. The total lake shipments are heavier than usual at this season, but only about half the average while navigation was open.

For the same 34 weeks the receipts at the different Atlantic ports have been:

	Corn.	Per cent. of total.	All grains.	Per cent. of total.
New York	22,181,687	34.6	60,490,270	47.8
Boston	6,972,844	10.9	10,015,439	7.9
Portland	617,476	1.0	1,051,256	0.8
Montreal	3,493,881	5.5	11,396,227	9.0
Philadelphia	14,320,025	22.3	22,118,235	17.5
Baltimore	14,188,700	22.1	18,091,585	14.3
New Orleans	2,323,787	3.6	3,382,600	2 7
Total	64,098,400	100.0	126,455,612	100.0

The receipts for the last week are heavy for the season, including, doubtless, considerable arrivals at New York by North River boats, which came from the canal.

Compared with their standing the previous week, New York has fallen considerably in rank in corn and has just held its own in all grains; Boston has fallen a trifle in all grains; Portland has gained a little in corn; Montreal has fallen off in both, its receipts being almost nothing in the winter; Philadelphia has just held its own; Baltimore has gained considerably in both; and New Orleans has also gained in both.

During the last week reported Baltimore received 42 per cent. of the total arrivals of corn at the seaboard; Philadelphia, 22 per cent.; New York, 13⅓; Boston, 10 per cent. Of grains of all kinds these percentages were: New York, 42; Baltimore, 25¼; Philadelphia, 18¼; Boston, 6¾; New Orleans, 5½.

The chief shipments of corn are now to Baltimore and Philadelphia, the two places during the last week getting 64 per cent. of the whole. These places were also the chief corn receivers last winter. That their corn receipts should be kept up or increase while New York's fall off is probably due to the fact that the old crop of corn is now nearly all marketed, and that there is not much of the new crop in condition to market yet, except what comes from the southern part of the corn-exporting district, which is nearer to the Southern cities and more fully connected with the Pennsylvania and the Baltimore & Ohio roads than with the trunk lines which carry exclusively to New York.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Rochester & State Line.—Extended from Leroy, N. Y., south by west to Pearl Creek, 10 miles.

Chicago & Lake Huron.—Extended west by south 6 miles to Lansing, Mich., completing the road.

Omaha & Republican Valley.—Extended west by south 16 miles to Wahoo, Neb.

North Pacific Coast.—Extended from Howard, Cal., northward to Moscow, 13 miles. It is of 3-ft. gauge.

This is a total of 45 miles of new railroad, making 2,278 miles completed in the United States in 1876, against 1,333 miles reported for the corresponding period in 1875, 1,844 in 1874, 3,630 in 1873, and 7,160 in 1872.

THE PRICE OF BREAD as affecting the advantages of the different seaport cities is discussed in a letter to one of the New York papers, by a writer who says that the difference in rates in favor of Baltimore and Philadelphia will make living so much dearer in New York as to drive manufactures and other industries away from it. The difference is now eight cents per barrel on flour, and the average yearly consumption of flour or other breadstuffs is about a barrel per inhabitant. Call it a barrel and a half, and we have the average New Yorker taxed 12 cents a year more than the average Baltimorean on account of the freight on his bread. That this burden of a cent a month (it will be less in summer, but never mind that) will immediately divert the manufactures of New York to Baltimore we will not say: we think it possible that such diversion may be prevented or at least postponed by a reduction of some of the other expenses of living—say house rent. If landlords would combine to reduce their rents one cent per month per occupant, their sacrifice would serve to neutralize this discrimination in freights and so prevent the decline and fall of the trade of New York. It would seem, however, that the diversion of manufactures should be to Albany and Buffalo rather than to Baltimore and Philadelphia; for while Baltimore gets its flour for eight cents less per barrel than New York, Albany has an advantage of one cent and Buffalo one of six cents over Baltimore. Further, it is hard to see why New York ever should have had any manufactures, for until last winter the difference in favor of Baltimore had always been ten cents a barrel. There are also, it is rumored, some differences in house rents and other expenses in favor of the smaller cities, so that the account in these days for a mechanic's family of five might stand something like this in the two cities:

	Baltimore.	New York.
House rent, per month	$10 00	$20 00
Flour, " "	3 75	3 80
Total	$13 75	$23 80

This indicates a difference of $10.05 cents per month in favor Baltimore in these two items—a very large sum in any mechanic's income, and sufficient of itself to affect greatly the progress of manufactures in the two cities. That we cannot deny, nor that five cents of the difference is due to the higher freight rates—and ten dollars to the higher rents—of New York.

THE TRUNK LINE AGREEMENT is published on another page The freight agents who were to settle the details under the agreement are said not to have reached a conclusion, after a prolonged session. There is said to be a dispute whether when freight is received at a seaport at the local rate and afterwards exported the drawback shall consist of the difference between the rail rate to Baltimore and that to New York, or of the difference in the rail rate to plus to ocean rate from the respective ports. If the latter, it would be necessary in every case to ascertain just what rate was paid by sea on the shipment in question, and also what was the rate to the same destination on the same day from the other ports. It would also tend to raise the ocean rates from the ports where the rail rates are highest, because it would be absolutely a matter of indifference to the shipper what he paid by sea, the railroad company guaranteeing that the total of the rail and the ocean rate should be as little as by any other port, and deducting from its own rate any addition to the ocean rate.

An arrangement which will cause the railroads to make good any inequalities in the rates for transfer and by sea is to be deprecated, as it will tend directly to prevent reductions in these rates, which at New York for the transfer are believed to be capable of a large reduction.

NOVEMBER EARNINGS are reported in our table for 27 railroads, with 14,016 miles of road, or 18⅔ per cent. of the total in the country. These roads on the average earned $549 per mile this year, against $591 in 1875, the decrease being 7 per cent.—a considerable falling-off. There was a larger mileage this year, and the total earnings were but $226,328, or 2 9 per cent., less than last year.

For the eleven months ending with November 24 roads report with 12,509 miles of road, or a sixth of the total. Their average earnings per mile have increased from $5,567 to $5,780, or by 3.9 per cent. Their total earnings are 6.2 per cent greater.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Bangor & Piscataquis.—The board has elected Moses Giddings and John S. Ricker directors in place of Charles Stetson and Noah Woods, and has chosen Mr. H. W. Blood, of Bangor, Me., Treasurer.

Massachusetts Central.—Mr. James M. Stone has been re-elected President for the ensuing year.

Denison & Mineola.—The first board of directors of this new Texas Company is as follows: John P. Leeper, Jot Gunter, John Nevins, W. B. Munson, Edwin D. Chaddick, R. C. Foster, J. T. Munson, J. S. Clifton, Edward P. Lingo.

Newport & Maysville.—At a meeting held in Newport, Ky., Dec. 19, this company was organized by the election of the following directors: Alfred Gaither, E. W. Woodward, W. H. Clement, C. W. West, G. C. Goss, J. H. Rhodes, Thomas D. Lovett. It is understood that Mr. Gaither is to be President.

Dallas & Cleburne.—The first board of directors of this new company is as follows: A. T. Obenchain, S. P. Hollingsworth, J. E. Hollingsworth, W. A. Obenchain, M. Pointer, J. S. Stewart, R. W. Goldthwaite. The officers are: A. T. Obenchain, President; S. P. Hollingsworth, Vice-President; J. E. Hollingsworth, Treasurer; W. A. Obenchain, Secretary. The office is in Dallas, Tex.

Connecticut Central.—Mr. Daniel D. Warren has been chosen President, in place of J. W. Phelps, absconded.

Springfield, Athol & Northeastern.—Mr. Henry W. Phelps is appointed Superintendent, in place of John W. Phelps.

Maryland & Delaware.—At the annual meeting in Easton, Md., recently, the following directors were chosen: A. Hardcastle, G. W. Goldsborough, Caroline County, Md.; E. M. Hardcastle, John W. Knotts, J. C. W. Powell, Thomas J. Clark, Talbot County, Md.; Wm. Slaughter, of Delaware; John W. Scott, Baltimore; C. W. Huntington, Boston. Messrs. Samuel Hambleton, Edward Lloyd and W. C. Satterfield are directors for the State of Maryland, and H. P. Hopkins for Talbot County. The board re-elected C. W. Huntington, President; John W. Scott, Secretary and Treasurer; John L. Caldwell, Superintendent.

Wheeling & Lake Erie.—At the annual meeting in Martin's Ferry, O., Dec. 19, the following directors (one-third of the board) were chosen for three years: A. K. Robinson, E. D. Otis, James Aiken, T. W. Chapman, Wm. Davidson. Mr. Chapman is the only one re-elected, the outgoing directors being Judge Cochran, Joseph Bell, Simon Beiter and Joel Wood, President of the company from its first organization.

Washington City, Virginia Midland & Great Southern.—Mr. Francis F. Marbury, of Alexandria, Va., has been appointed Paymaster.

Mississippi & Tennessee.—Mr. A. J. Knapp has been appointed General Freight Agent *vice* D. B. Morey, resigned. All reports and communications relating to the freight and passenger business should be addressed to A. J. Knapp, General Freight and Ticket Agent, Memphis, Tenn.

Danbury & Norwalk.—Mr. L. W. Sandiforth has been appointed Superintendent, with office at Danbury, Conn. Mr. Standiforth was for 25 years on the Rome, Watertown & Ogdensburg road, most of the time as a conductor.

Rome, Watertown & Ogdensburg.—Mr. Samuel Sloan, who is also President of the Delaware, Lackawanna & Western and the Michigan Central, has been chosen President of this com- in place of Mr. Marcellus Massey, who resigns on account of ill health. Mr. Massey remains with the company as Vice-President.

PERSONAL.

—Mr. H. H. Hunnewell, of Boston, a director of the Chicago, Burlington & Quincy and many other companies, and well known as a large holder of Western railroad securities, lost about $100,000 on the night of Dec. 18, his residence in Boston having been destroyed by fire.

—Mr. Edward C. Knight, President of the Central Railroad Company, of New Jersey, has resigned his position as President of the Guarantee, Trust and Safe Deposit Company of Philadelphia, in order to devote his whole time to the Central.

—John W. Phelps, Superintendent of the Springfield, Athol & Northeastern and President of the Connecticut Central, is reported to have run away with a young woman from Norwich, Conn., and it is believed that he has gone to Europe.

—Col. Gordon N. Peay, a prominent Arkansas lawyer and a director and Secretary of both the Little Rock & Fort Smith and the Little Rock, Mississippi River & Texas companies, died at his residence in Little Rock, Ark., Dec. 16.

—Gen. John Ross, at one time Superintendent of the old Portage Railroad in Pennsylvania, died at his residence at McVeytown, Pa., Dec. 20, aged 66 years. He has been somewhat prominent as a politician.

—The sale of the collection of pictures belonging to Mr. John Taylor Johnston, late President of the Central Railroad Company of New Jersey, which took place in New York last week, realized about $333,000. Some of the paintings brought more, many less than their cost to Mr. Johnston, the whole collection realizing a considerable profit, it is said. Among the larger buyers was President Garrett, of the Baltimore & Ohio.

—Mr. David Crawford, a well-known banker of New York, died in that city Dec. 24. He was formerly a director of the New York Central and of the Chicago, Rock Island & Pacific, and was one of the first and most active directors of the Missouri, Kansas & Texas.

—Mr. Marcellus Massey has resigned his position as President of the Rome, Watertown & Ogdensburg Company on account of impaired health. He has been chosen Vice-President and will give such attention to the company's affairs as his health will permit.

— Mr. H. W. Franklin, Superintendent of the Housatonic Railroad, died at his residence in Canaan, Conn., Dec. 27, at the age of 40 years.

— Mr. L. H. Sellars has resingned his position as Superintendent of the Pensacola & Louisville Railroad.

— On Christmas day the telegraph operators of the Eastern Division, New York Centtral & Hudson River Railroad, united in presenting a valuable silver set to Mr. Fred H. Phillips, of Little Falls, N. Y., Chief Operator of the division, and the oldest telegrapher in service on the road.

TRAFFIC AND EARNINGS.

Railroad Earnings.

Earnings for various periods are reported as follows:

	1876.	1875.	Inc. or Dec.		P. c.
Eleven months ending Nov. 30:					
New Jersey Midland.	$603,498	.....	.....		....
Philadelphia & Erie.	3,054,686	$3,094,455	Dec..	$39,769	1.3
Expenses.....	2,037,882	2,096,282	Dec..	58,400	2.8
Net earnings.....	$1,016,804	$998,173	Inc...	$18,631	1.9
Per cent. of exps..	66.68	67.74	Dec..	1.06	1.6
St. Paul & Sioux City	533,468	492,657	Inc...	40,811	8.3
Expenses.....	325,766	.....	.....	.....	....
Net earnings.....	$207,702	.....	.....	.....	....
Per cent. of exps..	61.50	.....	.....	.....	....
Sioux City & St. Paul.....	333,706	$277,247	Inc...	$56,459	20.0
Expenses.....	227,427	.....	.....	.....	...
Net earnings.....	$106,279	.....	.....	.....	....
Per cent. of exps..	68.00	.....	.....	.....	....
Second week in December:					
Atchison, Topeka & Santa Fe.....	$40,868	$41,374	Inc ..	$8,494	20 5
Denver & Rio Gra'de, Main Line.....	8,185	7,506	Inc...	679	9.0
Denver & Rio Gra'de, Trinidad Ex.....	3,241	.....	.....	.....	....
St. Louis, Iron Mt. & Southern.....	139,200	132,159	Inc...	7,041	5.3
Third week in December:					
Chicago, Milwaukee & St. Paul.....	$138,000	$162,376	Dec..	$24,376	15.0
Week ending Dec. 2:					
Grand Trunk.....	£33,000	£41,900	Dec..	£8,900	21.2

Chicago receipts and shipments for the week ending Dec. 23 were:

	1876.	1875.	Increase.	P. c.
Receipts.....	1,138,644	897,866	240,778	26.5
Shipments.....	600,445	333,020	267,425	80.3

Coal Movement.

Coal tonnages for the week ending Dec. 16 are reported as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Anthracite.....	391,530	390,969	Inc .. 561	0.14
Semi-bituminous.....	62,174	53,692	Inc .. 8,482	15.80
Bituminous, Pennsylvania.....	42,470	42.331	Inc .. 139	0.33

The December auction sales of anthracite in New York show a slight improvement in prices. San Francisco coal receipts for November were 47,400 tons. For the eleven months ending Nov. 30 the receipts were: 1876, 580,700; 1875, 481,000; increase, 99,700 tons, or 20.7 per cent. The increase was mainly in coal from Washington Territory, British Columbia and England.

St. Louis Freights.

The roads running into St. Louis from the eastward have resolved that on and after Jan. 1, 1877, all rates on west-bound traffic coming from points east of St. Louis and destined to St. Louis, be made to East St. Louis only.

The effect of this is to throw the cost of transferring freight across the Mississippi at St. Louis, by bridge or ferry, upon the receivers of freight there, and to give them the choice of the transfers, which they have been demanding while the rate to East St. Louis was the same as that to St. Louis, and included the bridge and transfer charges.

Grain Movement.

For the week ending Dec. 16 receipts and shipments are reported as follows, in bushels:

	1876.	1875.	Increase.	P. c.
Lake ports' receipts.....	2,732,511	2,129,850	602,661	28.3
" " shipments.....	1,380,152	742,915	637,237	85.8
Atlantic ports' receipts.....	2,246,444	1,835,211	411,233	22.4

The shipments from lake ports, as in other years at this season, were entirely by rail.

THE SCRAP HEAP.

Railroad Manufactures.

It is stated that the Union Car Spring Company, of New York, has been bought out by some parties residing in Bridgeport, Conn., who will remove the works to that city.

The Catasauqua Manufacturing Company's mills, at Catasauqua and Ferndale, Pa., are running full double turn.

The interest of John H. Schaefler in the firm of J. H. Cofrode & Co. ceased, Dec. 20, by mutual consent, and the firm is dissolved. The business will be continued by the remaining partners, Joseph H. Cofrode and Francis H. Saylor, who have formed a copartnership under the same firm name of J. H. Cofrode & Co., engineers and bridge-builders, who will execute all the contracts and settle the accounts of the old firm.

The Allentown (Pa.) Rolling Mill Company's works are running on orders for rails.

The Lehigh Crane Iron Company, at Catasauqua, Pa., has three furnaces in blast, two on foundry iron and one on Bessemer iron.

Stewart Furnace, at Sharon, Pa., is running on Bessemer iron.

The Denver (Col.) Iron Works are to be enlarged. They have been employed chiefly on mining machinery, but intend to engage in general work and in the manufacture of iron bridges.

At the Pottstown (Pa.) Iron Company's Works the slag and cinder are now being prepared for use as track ballast and sold to the Reading road.

The Rogers Locomotive Works, at Paterson, N. J., have been shipping some engines for the Missouri, Kansas & Texas road.

The Cincinnati Bridge Company has a contract for a long highway bridge in Darke County, O.

The Vulcan Iron Works at St. Louis are making steel rails for the Galveston, Harrisburg & San Antonio road.

The St. Charles (Mo.) Manufacturing Company has an order for 100 box cars for the Missouri, Kansas & Texas.

The United States Rolling Stock Company has leased 250 box cars to the Hannibal & St. Joseph road.

The Massillon (O.) Bridge Company is so full of work that the shops are running 12 hours a day.

Roofs of Large Span.

The London *Times* says: "The desire to construct the largest single roof in the world was achieved in the roof of the Midland Railway station at St. Pancras, which now possesses that distinction, having eclipsed the roof of the Imperial Riding School at Moscow by a few feet, the span of the former being 240 feet, and that of the latter 235 feet. But, apart from ambitious motives, the principal reason for adopting these large single spans is that it obviates the necessity for columns or other intermediate supports which hamper the station arrangements and interfere with alterations should they become necessary. The most recent examples of large span roofs are to be found at Glasgow and Manchester, both of which are in course of construction. The Glasgow roof is to cover the large new station at St. Enoch square for the Glasgow Union Railway, and which is to be used by the Glasgow & Southwestern and Midland railways. The roof, which is well advanced toward completion, is of the same general character as that of the Midland Railway, already referred to. It is, however, smaller, the Glasgow roof having a span of 198 feet and a length of 518 feet, as against a span of 240 feet and a length of 689 feet in the Midland roof. The new roof will be 90 feet high from platform level, and will be supported by fifteen main ribs, twelve of which have already been erected in place, and the iron-work for the remaining three is being sent for. The total weight of the iron-work in this roof is about 1,400 tons. The roof at Manchester is for the new joint-station of the Midland, the Great Northern, and the Manchester, Sheffield & Lincolnshire railways, and the works have recently been commenced. The design is also of the same character as that of the St. Pancras roof, the span being 210 feet and the length 550 feet. The cast and wrought iron will weigh upward of 2,300 tons, of which nearly the whole will be in the roof itself."

An Infernal Machine.

Those are reckless boys at the depot baggage-room. The way they handle things this cold weather is a caution to travelers. Some of them will get hurt some day. But they got a set-back yesterday. We wandered around that way about two o'clock to see them make the brass-head trunk nails fly in the frosty air. A drummer was standing against the butting post just outside the door, and he winked at us as we went in. Smith was on duty with Drury, and he hauled a Saratoga down from the top of a great pile of trunks and let it fall with a smash that jammed in one handle and loosened the top, and then he uncoiled a rope and tied her up and threw a small sample case across the room on to a truck. A great, big sample case was pushed off on to a little cheap russet trunk, and the pieces of the little trunk with the contents were shoveled into a bag and the check was tied on with a string. The next trunk was a dirty-looking, worn-out, black, little trunk tied up with a rope, and it was dreadful to witness Smith's eyes dilate as he approached the tender and defenseless trunk. But just as he touched the handle of that trunk he wilted. His eyes bunged out with horror, and the boys took their feet down off the stove and gathered around him with anxious faces. He muttered "Thomassen!" and pointed to the floor, where a handful of powder lay, evidently sifted through the bottom of the trunk. Silently but persistently the loafers recalled sundry business engagements and departed. *The Hawk-Eye* remained, only taking the precaution to present the side of his face to the imminent explosion. Smith and Drury consulted. "It's just that kind of a trunk," said Smith. "It looks suspicious anyhow," said Drury. "What'll we do with it?" "Let's open it and see what's inside!" "How does it go?" said Drury. "East." "Well, then, let's send her off and get rid of her." And they went and got overcoats and piled up on the floor, and both of them engineered that trunk, tenderly, carefully, solicitously. They wouldn't trust it on the truck with the other trunks for fear the jar would explode it, but they carried it down the platform between them. We followed them out until we were attracted by that drummer again. He winked again. "That's

RAILROAD EARNINGS IN NOVEMBER.

Name of Road.	Mileage.					Earnings.					Earnings per Mile.	
	1876.	1875.	Inc.	Dec.	Per c.	1876.	1875.	Increase.	Decrease.	Per c.	1876.	1875.
Atchison, Topeka & Santa Fe	711	629	82	.....	13.0	$225,935	$187,183	$38,772	.....	20.7	$318	$298
Burlington, Cedar Rapids & Northern	401	401	.....	.....	.....	94,908	127,879	.....	$32,971	25.8	239	319
Cairo & St. Louis	146	146	.....	.....	.....	20,129	27,934	.....	7,805	28.0	138	192
Canada Southern	452	452	.....	.....	.....	148,050	134,290	13,760	.....	10.2	328	297
Central Pacific	1,635	1,315	320	.....	24.3	1,673,000	1,813,836	159,164	.....	10.5	1,023	1,151
Chicago & Alton	650	650	.....	.....	.....	377,553	395,779	.....	18,226	4.6	581	609
Chicago, Milwaukee & St. Paul	1,400	1,400	.....	.....	.....	766,000	927,030	.....	161,030	17.4	547	662
Cincinnati, Lafayette & Chicago	75	75	.....	.....	.....	27,171	34,287	.....	7,116	20.7	362	457
Denver & Rio Grande	206	120	86	.....	71.7	44,137	30,411	13,726	.....	45.2	214	253
Illinois Central	1,109	1,109	.....	.....	.....	580,106	773,092	.....	192,986	25.0	523	697
Indianapolis, Bloomington & Western	344	344	.....	.....	.....	93,646	141,300	.....	47,654	33.7	272	411
International & Great Northern	507	459	48	.....	10.5	214,200	188,466	25,734	.....	13.7	422	411
Louisville & Nashville	921	921	.....	.....	.....	466,378	485,326	.....	18,948	3.9	506	527
Michigan Central	804	804	.....	.....	.....	541,345	587,270	.....	45,925	7.8	673	730
Missouri, Kansas & Texas	786	786	.....	.....	.....	324,886	300,534	24,352	.....	8.1	413	382
Nashville, Chattanooga & St. Louis	341	341	.....	.....	.....	153,390	147,193	6,197	.....	4.2	450	432
New Jersey Midland	86	86	.....	.....	.....	65,981	59,055	6,926	.....	11.7	767	687
Philadelphia & Erie	288	288	.....	.....	.....	307,900	295,737	12,163	.....	4.1	1,069	1,027
Rome, Watertown & Ogdensburg	410	333	77	.....	23.1	133,487	115,068	18,419	.....	16.0	326	346
St. Louis, Alton & T. H.—Belleville Line	71	71	.....	.....	.....	48,289	50,700	.....	2,411	4.8	680	714
St. Louis, Iron Mountain & Southern	685	685	.....	.....	.....	466,000	429,765	36,235	.....	8.4	680	627
St. Louis, Kansas City & Northern	504	504	.....	.....	.....	282,845	230,526	52,319	.....	22.6	561	458
St. Louis & Southeastern	349	349	.....	.....	.....	95,578	99,606	.....	4,028	4.0	274	285
St. Paul & Sioux City	122	122	.....	.....	.....	55,467	72,015	.....	16,548	23.6	455	590
Sioux City & St. Paul	148	148	.....	.....	.....	35,492	46,660	.....	11,168	24.0	240	315
Toledo, Peoria & Warsaw	237	237	.....	.....	.....	101,075	123,920	.....	22,845	18.4	426	519
Toledo, Wabash & Western	628	628	.....	.....	.....	351,594	395,927	.....	44,333	11.2	560	630
Totals	14,716	13,403	613	.....	.....	$7,694,562	$7,920,890	$407,666	$633,994	.....	$549	$591
Total increase or decrease	.....	.....	613	.....	4.6	.....	.....	.....	226,328	2.9	.....	.....

RAILROAD EARNINGS, ELEVEN MONTHS ENDING NOV. 30.

Name of Road.	Mileage.					Earnings.					Earnings per mile.				
	1876.	1875.	In.	Dec	Per c.	1876.	1875.	Increase.	Decrease	P.c.	1876.	1875.	Inc.	Dec.	P.c.
Atchison, Topeka & Santa Fe	696	535	161	....	.....	$2,822,298	$1,376,004	$906,294	.....	65.9	$3,279	$2,572	$707	.....	27.5
Burlington, Cedar Rapids & Northern	401	401	....	....	30.1	1,037,583	1,200,574	.....	$162,991	13.6	2,587	2,994	.....	$407	13.6
Cairo & St. Louis	146	138	8	....	5.8	246,181	254,338	.....	8,157	3.2	1,686	1,843	.....	157	8.5
Canada Southern	452	452	....	....	.....	1,571,781	1,127,834	443,947	.....	39.4	3,477	2,496	981	.....	39.4
Central Pacific	1,344	1,303	41	....	3.1	16,773,166	15,696,854	1,076,312	.....	6.9	12,480	12,047	433	.....	3.6
Chicago & Alton	650	650	....	....	.....	4,595,831	4,287,452	308,379	.....	7.2	7,071	6,596	475	.....	7.2
Chicago, Milwaukee & St. Paul	1,400	1,399	1	....	.....	7,445,139	7,507,850	.....	62,711	0.8	5,318	5,367	.....	45	0.9
Cincinnati, Lafayette & Chicago	75	75	....	....	.....	342,874	362,850	.....	19,976	5.5	4,572	4,838	.....	266	5.5
Denver & Rio Grande	168	120	48	....	40.0	428,576	324,448	104,128	.....	32.1	2,551	2,704	.....	153	5.7
Illinois Central	1,109	1,109	....	....	.....	6,547,607	7,123,122	.....	575,515	8.1	5,904	6,423	.....	519	8.1
Indianapolis, Bloom. & West'n	344	344	....	....	.....	1,349,148	1,214,680	134,468	.....	11.1	3,922	3,531	391	.....	11.1
International & Gt. Northern	468	459	9	....	2.0	1,231,858	1,175,443	56,415	.....	4.9	2,632	2,561	71	.....	2.8
Louisville & Nashville	921	921	....	....	.....	4,637,479	4,296,938	340,541	.....	7.9	5,035	4,666	369	.....	7.9
Michigan Central	804	804	....	....	.....	6,255,724	6,069,899	185,825	.....	3.1	7,781	7,550	231	.....	3.1
Missouri, Kansas & Texas	786	786	....	....	.....	2,920,811	2,609,187	317,624	.....	11.9	3,716	3,320	396	.....	11.9
Nashville, Chattanooga & St. L.	341	341	....	....	.....	1,564,877	1,468,081	96,796	.....	6.6	4,589	4,305	284	.....	6.6
Philadelphia & Erie	288	288	....	....	.....	3,054,686	3,094,455	.....	39,769	1.3	10,607	10,745	.....	138	1.3
St. Louis, Alton & Terre Haute, Belleville Line	71	71	....	....	.....	443,843	511,044	.....	67,201	13.1	6,251	7,198	.....	947	13.1
St. Louis, Iron Mt. & Southern	685	685	....	....	.....	3,509,949	3,305,292	204,657	.....	6.2	5,124	4,825	299	.....	6.2
St. Louis, Kansas City & North'n	504	504	....	....	.....	2,874,843	2,378,165	496,678	.....	20.9	5,704	4,719	985	.....	20.9
St. Louis & Southeastern	349	349	....	....	.....	1,011,947	913,161	98,786	.....	10.8	2,900	2,617	283	.....	10.8
St. Paul & Sioux City	122	122	....	....	.....	533,468	492,657	40,811	.....	8.3	4,373	4,038	335	.....	8 3
Sioux City & St. Paul	148	148	....	....	.....	333.706	277,247	56,459	.....	20.0	2,255	1,873	382	.....	20.0
Toledo, Peoria & Warsaw	237	237	....	....	.....	1,313,667	1,006,726	306,941	.....	30.5	5,543	4,248	1,295	.....	30.5
Totals	12,509	12,241	268	....	.....	72,307,042	68,074,301	$5,160,061	$936,320	.....	$5,780	$5,561	$219	.....	3.9
Total increase	.....	.....	268	....	2.2	.....	.....	4,232,741	.....	6.2	.....	.....	.....	.....	.....

mine," says he. "I always do that." "Always do what?" we queried with a reporter's instinct. "Always wear that trunk and sprinkle powder on the floor. Quite a spec, you see. Saves my samples and then every three weeks I charge the house with a new sample case. Clear gain. Clear gain." And he chuckled as he turned into the waiting room for a cup of coffee.—*Burlington Hawkeye.*

A German Military Railroad.

The *Nord-deutsche Allgemeine Zeitung* prints an account of the military railroad which has been laid down by the men of the "railroad regiment" of the Prussian army. The whole length of the line is 45.6 kilometers (28¼ miles). It is connected at Berlin and at Zossen with the line from Berlin to Dresden, and runs on the same level as that railway. At Zossen the line branches off to the artillery shooting ground. This military railroad is, of course, chiefly used for military purposes, but it also conveys goods and passengers for the general public. The administration is under the direction of the commandant of the "railroad regiment," a staff officer and two lieutenants, who report to the chief of the general staff of the army and the railway inspectors. The personnel of the administration is composed almost entirely of members of the regiment; a captain acts as manager, two lieutenants as chief clerk and head engineer respectively, another officer looks after the stores and rolling stock, and a fifth acts as paymaster. The eight companies of the "railroad regiment," with their officers, each serve in turn for about six months on the road. There is a line of telegraph, which is worked by the officer acting as chief clerk and a non-commissioned officer as "telegraph superintendent." During the past year six non-commissioned officers have served on this railroad as engine-drivers, nine pioneers as stokers, eight non-commissioned officers as guards and sixteen pioneers as porters and workmen in various capacities, and the passenger traffic consisted of 4,074 soldiers and 2,362 civilians.

The road has been built for some time, chiefly to give access to the great artillery practice grounds. Some time ago it applied for admission into the German Railroad Union.

The Springfield Iron Company.

During the month of November this company's works at Springfield, Ill., made 2,890 tons of iron rails, making a total since the 1st of January last of 25,468 gross tons. They have been of all weights, from 30 to 61 pounds per yard.

In order to meet a growing demand and to fully maintain its reputation as to the quality of work, the company has resolved to make rails hereafter under the reheating process. It is now remodeling its works for that purpose. They will be prepared to make a pile 12 inches square which will be brought up to a welding heat in the gas furnaces. It will then be given a few passes in the rolls and reduced to a bloom about 5¼ by 6¼ inches. This will be charged back into a gas furnace and, after being brought up again to a welding heat, rolled into the finished rail.

It is expected that by this heating and reheating in the Siemens gas furnaces the works will make a very superior rail.

The company is also preparing to complete its steel works, which it hopes to have in operation by June 1. The plant will consist of Siemens-Martin furnaces and the product will be rails, boiler plate, axles, springs and general merchant shapes of steel. The plans are from Mr. A. L. Holley, under whose supervision the works will be completed.

OLD AND NEW ROADS.

Grand Trunk.

The circular of General Manager Hickson, to which reference was made last week, is as follows:

"In consequence of the great depression in trade and the falling off in the company's business, it has been determined to discontinue a large number of trains on and after the 23d instant.

"The reduction will, as far as I am able to estimate, amount to 20 per cent. of the train service. This, I very much regret, will necessitate a large reduction in the number of engine drivers, firemen, train-hands and others employed by the company. The heads of the several departments of the service will take the necessary steps to prepare for this change forced upon the company by a continuous stagnation in business and the competition resulting from the construction of rival lines.

"In reducing the staff employed, care must be taken to give every consideration to the claims of old employes, and that the reductions are spread over the various grades in equitable proportions."

Montreal dispatches say that a strike of the enginemen is feared, the men claiming that many old employes have been discharged and newer ones retained, and charging that those discharged are all members of the Brotherhood of Locomotive Engineers, and that the object of the management is to break up the Brotherhood on the road.

Chicago, Milwaukee & St. Paul.

Notice is given that, in pursuance of the terms of the mortgage, 53 of this company's consolidated sinking fund bonds have been drawn for redemption and will be paid on presentation at the company's office in New York. Interest on them will cease July 1, 1877. The numbers of the bonds drawn are: 31, 282, 350, 530, 603, 1,158, 1,191, 1,223, 1,431, 1,471, 1,482, 1,485, 1,673, 1,744, 1,774, 1,813, 2,054, 2,105, 2,121, 2,181, 2,205, 2,305, 2,415, 2,536, 2,639, 2,678, 2,729, 2,765, 2,808, 2,812, 2,865, 2,910, 2,925, 3,096, 3,124, 3,245, 3,309, 3,315, 3,452, 3,508, 3,559, 4,073, 4,172, 4,309, 4,538, 5,038, 5,256, 5,294, 5,298, 5,326, 5,462, 5,473, 5,617.

Cincinnati Southern.

The tunnel, 2,525 feet long, in section 140, is completed and ready for the rails to be laid. It is the longest one on the line except the King's Mountain tunnel, and was a difficult piece of work, through limestone rock.

Nashville, Chattanooga & St. Louis.

This company's report for the five months of its fiscal year, from July 1 to Nov. 30, is as follows:

	1876.	1875.	Inc. or Dec.	P.c.
Gross earnings	$682,044 71	$710,449 88	Dec.. $28,405 17	4.0
Exp's and taxes	427,934 61	398,693 47	Inc.. 29,241 14	7.3
Net earnings	$254,110 10	$311,756 41	Dec.. $57,646 31	18.5

The expenses this year were 62.75 per cent. of earnings; the earnings were $2,000 gross, and $745 net per mile.

Chicago, Burlington & Quincy.

At the special meeting in Chicago to vote on the purchase of the St. Louis, Rock Island & Chicago, Mr. J. N. A. Griswold, Chairman of the board, said that the directors propose to provide for the purchase by the issue of the company's plain 5 per cent. bonds, having 25 years to run, which are to be secured by first-mortgage bonds of equal amount on the St. Louis, Rock Island & Chicago Railroad, bearing 7 per cent. interest per annum, to be deposited with trustees, who will apply the 7 per cent., first to payment of interest on the 5 per cent. bonds, and the residue of 2 per cent. per annum to constitute a sinking fund for the 5 per cent. bonds. This sinking fund would absorb the full amount of the 5 per cent. bonds at par in 25 years. It is proposed to make the issue of bonds $2,500,000, of which so much will be disposed of now as will pay off the two millions needed, and the remainder to be held in reserve for future needs of the St. Louis, Rock Island & Chicago road, if so required.

Delaware, Lackawanna & Western.

A semi-official statement is made to the effect that the company's net earnings, after paying all interest and rental charges, amount to a little over 1½ per cent. on the stock. It is not intended, however, to declare any dividend for the present quarter.

Dividends.

Dividends have been declared by the following companies:

New York, New Haven & Hartford, 5 per cent., semi-annual, payable Jan. 2.

New York & Harlem (New York Central & Hudson River, lessee), 4 per cent., semi-annual, payable Jan. 2.

Old Colony, 3 per cent., semi-annual, payable Jan. 2.

Providence & Worcester, 4 per cent., semi-annual, payable Jan. 2.

Union Pacific, 2 per cent., quarterly, payable Jan. 2.

Western Union Telegraph, 1¼ per cent., quarterly, payable Jan. 2.

New York Central & Hudson River, 2 per cent., quarterly, payable Jan. 15.

Chicago, Rock Island & Pacific, 2 per cent., quarterly, payable Feb. 1.

Illinois Central, 2 per cent., semi-annual, payable Feb. 1.

United New Jersey, 2½ per cent., quarterly, payable Jan. 10.

Delaware, 3 per cent., semi-annual, payable Jan. 2.

Camden & Atlantic, 2 per cent., quarterly, payable Jan. 15.

Lehigh Valley, 2 per cent., quarterly, payable Jan. 15.

Georgia, 3 per cent., semi-annual, payable Jan. 15.

The Illinois Central drops from 4 to 2. It has paid 8 per cent. yearly for about four years. Previously it paid 10 per cent. for many years.

St. Louis, Kansas City & Northern.

In the suit brought against this company by the Attorney General of Missouri the St. Louis Court of Appeals has decided that the company had a right to construct and that it can legally continue to maintain and operate the branch from Ferguson to the Union Depot in St. Louis.

Philadelphia & Reading.

Philadelphia papers state that this company has secured the necessary temporary loans to enable it to carry over its floating debt until next April, when it is believed that all its difficulties can be adjusted.

New Orleans, St. Louis & Chicago.

In the United States Circuit Court at New Orleans, Dec. 20, a decision was given granting a decree of foreclosure of the mortgage made to secure the bonds held by the Illinois Central Company. The trustees, John Newell and J. B. Alexander, are ordered to sell the property at public sale, after due notice given, provided the indebtedness under the mortgage is not paid up by Jan. 1.

Albany & Susquehanna.

The repair shops at Albany are to be closed and the work taken to the Oneonta shops, the object being to secure greater economy. The Oneonta shops are large enough to do all the work of the road and there will be a saving in expenses of management.

Omaha & Republican Valley.

Track on this road is laid to Wahoo, Neb., the county seat of Saunders County, 19 miles west by south from the junction with the Union Pacific at Valley Station. The road will be opened for traffic in a few days, and will be worked as a branch of the Union Pacific.

Pensacola & Louisville.

Mr. W. D. Chipley, General Manager, who assumed charge of this road Dec. 16, informs us that the name has been changed, and that it will hereafter be known as the Pensacola Railroad.

Northern Pacific.

Work has been begun at Tacoma, Wash. Ter., on a branch or extension of the Pacific Division, which is to be about 25 miles long, from Tacoma to the coal mines of the Puyallup Valley.

Meetings.

The following companies will hold meetings at the times and places given:

Delaware, annual, at the company's office in Dover, Del., Jan. 11, at 12.30 p. m.

Philadelphia, Wilmington & Baltimore, annual, at the company's office in Wilmington, Del., Jan. 8, at 1 p. m.

Texas & Pacific.

The House Committee on Pacific Railroads has referred all bills and propositions in regard to this road to a special committee consisting of Messrs. Atkins, Lamar, O'Neil, Garfield and Luttrell, who are to report them at the next meeting of the full committee, which is ordered for Jan. 4, until which time the committee adjourned.

There is probably a better chance for securing Government aid this year than last, when the impending Presidential election made both parties unusually cautious about favoring a measure which might be used against them in the canvass.

The Trunk Lines' Agreement.

The following is given as the text of the agreement recently made between the New York Central & Hudson River, the Erie, the Pennsylvania and the Baltimore & Ohio railroads, relative to the governance of freight rates on traffic to the different ports:

The New York Central & Hudson River Railroad Company, the Erie Railway Company, the Pennsylvania Railroad Company and the Baltimore & Ohio Railroad Company, in order to settle all questions now at issue between them with regard to rates to and from competitive points beyond the Western termini of their roads and to and from competitive points east of their Eastern termini, and to establish equal rates to and from the seaboard upon all competitive business, and adjust upon an equitable basis business purely local, do agree as follows:

First—That the trunk lines fix the rate on all west-bound traffic, and that the Western connections of the trunk lines shall fix the rates on all east-bound traffic from competitive points in the West, Northwest and Southwest, and that all competitive freight shipped on through bills of lading to Europe, the British Provinces, or the coast of America, shall be at the same through rate to destination, whether through the cities of Baltimore, Philadelphia, New York, Boston or Portland.

Second—That all freight shipped to Baltimore, Philadelphia and New York, locally, and afterwards exported or sold for export, foreign or coastwise, shall be deemed competitive.

Third—That on freights from all competitive points in the West, Northwest and Southwest to Baltimore, Philadelphia and New York, intended for local use and consumption, the rates

shall be 13 per cent. less to Baltimore and 10 per cent. less to Philadelphia than to New York from Chicago, or any point east thereof; and from St. Louis, Indianapolis, Cincinnati, Louisville, and all other competitive points east of St Louis, the rates to Baltimore shall be 14 per cent. less and to Philadelphia 9 per cent. less than to New York.

Fourth—That the rate of charge for elevation and storage of grain at the elevators with which the railroads connect, after being fixed, shall not be varied nor the terms or amount of service performed changed, without notice to all parties to this agreement; that until all the New York roads are directly connected with elevators the present general system of deliveries of grain in New York shall be considered the same as the service performed by elevators at Baltimore and Philadelphia, with the right, on the part of the New York roads, if they deem proper, to give in their elevators, lighters or barges the same number of days' free storage as are given by the elevators at Baltimore and Philadelphia.

Fifth—That the rates, terms and service at Boston shall at no time be less than New York.

Sixth—That the principle and provisions of this contract shall apply to all west-bound traffic passing over the respective roads first above-named, from American or European competitive points, at or east of their respective Eastern termini, to all competitive points West, Northwest or Southwest of their respective Western termini.

Seventh—That the general freight agents of the roads herein named shall adopt rules and regulations to carry into effect the foregoing agreement, subject to the approval of the executive officers of the respective companies.

Memphis & Raleigh.

This road, which extends from near Memphis, Tenn., to Raleigh, about seven miles, has not been worked for some time and Shelby County has judgments against the company for some $25,000 for money advanced and coupons unpaid. Recently, by consent of the county, the equipment was leased to the Holly Springs, Brownsville & Ohio Company, on the giving of sufficient security by that company.

Denver & Rio Grande.

This company has asked Congress to repeal so much of the act giving it a land grant as requires the road to be completed to Santa Fe, N. M., by June, 1877, and to build 50 miles a year thereafter.

Gilman, Clinton & Springfield.

There is talk of an extension of this road from Springfield, Ill., southward to Litchfield on the St. Louis, Alton & Terre Haute road, about 45 miles. This extension would, with the old road, the Illinois Central and the St. Louis, Alton & Terre Haute, complete a new line from Chicago to St. Louis about 292 miles long, or nine miles longer than the Chicago & Alton. The extension would also connect with the Toledo, Wabash & Western's St. Louis Division at Litchfield.

Houston & East Texas.

President Bremond states in a letter that the intention of this company is to build from Houston, Tex., north by east to Nacogdoches, about 140 miles. If sufficient inducements are offered the road will be extended 80 miles further to Jefferson, and a branch built to connect with the Southwestern & Rio Grande road to Shreveport.

Canada Southern.

It is again reported that this company will complete the Chicago and Canada Southern Division to Eden, O., 25 miles west by south from the present terminus at Fayette. The road is graded the whole distance. The Detroit, Eel River & Illinois road has agreed, if this is done, to extend its road from Butler, Ind., the present terminus, east to Eden, about nine miles. It is said that the use of the Baltimore & Ohio track can be obtained from Auburn Junction, the Eel River Crossing, to Chicago, 146 miles, and a line can thus be made 262 miles from Grosse Isle, or 276 miles from Detroit to Chicago, besides securing a connection to Logansport.

Wheeling & Lake Erie.

At the recent annual meeting all the retiring directors but one, including President Wood, were left out and new men chosen, who were nearly all from the northwestern end of the line.

The contractors, McKee & Darrah, have a considerable force at work on the section from Norwalk, O., to Sandusky. A smaller force is also at work on the tunnels near the Wheeling end of the line.

Connecticut Valley.

Notice is given that the payment of interest on the first-mortgage bonds of this company will be postponed for a short time. Notice of the day of payment will be duly given. This course is rendered necessary by reason of the payments made for interest due July last and for rails and locomotive purchased since Sept. 1, 1876.

Boston & New York Air Line.

The new span in the bridge over the Connecticut River at Middletown, Conn., has been completed and satisfactorily tested. It is 209 feet long, and replaces the one carried away by a steamboat during the high water of last March. It was erected without stopping travel over the temporory bridge which has been in use since the accident.

Georgia Western.

The graded road-bed and other property of this company is to be sold at public sale in Atlanta, Ga., Feb. 1. It is stated that arrangements have been made to buy the property and complete the line as a narrow-gauge road from Atlanta westward to Douglasville, about 25 miles.

Flint & Pere Marquette.

It is said that work will be begun in the spring on an extension of the Otter Lake Branch from Otter Lake, Mich., northeastward through Tuscola, Sanilac and Huron counties to Lake Huron.

Newport & Maysville.

The subscribers to the stock met in Newport, Ky., Dec. 19, and completed the organization of the company, 10,023 shares being represented. The proposed line is from Newport east by south up the Ohio to Maysville, about 55 miles.

Dallas & Cleburne.

A company by this name has completed an organization under the Texas general law to build a railroad from Dallas, Tex., west by south to Cleburne, about 45 miles.

Denison & Mineola.

A company has been organized by this name under the new Texas law to build a railroad from Denison, Tex., the junction of the Missouri, Kansas & Texas and the Houston & Texas Central, southeast to Mineola on the Texas & Pacific, about 110 miles. The capital stock is to be $2,000,000.

Memphis & Little Rock.

Pursuant to a decree of foreclosure granted by the United States Circuit Court, Alfred Sully, Commissioner, will sell this road at public sale in Little Rock, Ark., Feb. 27, 1877. The sale will be made in three lots, first the land grant; second the property covered by the mortgage of 1860, and lastly the property covered by the mortgage of 1873, including all the road, property and franchises of the present company. The sale will be made subject to all debts and liabilities of the Receiver, and the purchaser will be required to pay a sufficient amount where it connects with the Pittsburgh, Fort Wayne & Chicago, of cash to pay such debts, with the costs of suit; the balance of the purchase money may be paid in bonds and unpaid coupons of the company.

West Point & Hanover Junction.

This road is to run from Hanover Junction, Va., the crossing of the Chesapeake & Ohio and the Richmond, Fredericksburg & Potomac roads, east by south to West Point on York River, about 45 miles. It is designed to form a line to deep water for the heavy traffic of the Chesapeake & Ohio Railroad, especially for coal and oil, and the company expects to make West Point an important shipping port.

St. Paul & Sioux City.

The operations of this road for November were as follows:

Freight earnings		$42,872 49
Passengers		10,225 29
Express, mail and miscellaneous		2,369 07
Total ($455 per mile)		$55,466 85
Working expenses (47.2 per cent.)		26,308 39
Net earnings ($239 per mile)		$29,158 46
Rents received		122 68
Balance from previous month		145,345 44
Total		$174,626 58
State taxes	$1,109 34	
Insurance	308 35	
		1,417 69
Balance Dec. 1		$173,208 89

As compared with November, 1875, there is a decrease of 23 per cent. in gross and 13.6 per cent. in net earnings. For the eleven months ending Nov. 30 the gross earnings were $533,468.01; net, $207,702.12, being an increase of 8.3 per cent. in gross and of 44.8 per cent. in net earnings.

Rochester & State Line.

The new contractor is pushing work vigorously and track is now laid to Pearl Creek, N. Y., 10 miles south by west from the late terminus at Leroy and 35 miles from Rochester. It is expected that the line will reach Warsaw, eight miles further, by Jan. 1.

Lawrence Ore.

The contractors, McClain & Funkhauser, have completed about three miles of the grading of this road, and will begin laying track shortly. The road is to run westward about five miles from Wampum on the New Castle & Beaver Valley Railroad, in Lawrence County, Pa., and is intended to serve several iron mines.

Alabama & Chattanooga.

Pursuant to order of the United States Circuit Court, Robert W. Healy and Nathaniel W. Trimble, Special Commissioners, will sell this road at public sale in Mobile, Ala., Jan. 22. No bid for less than $300,000 will be received; the purchasers will be required to pay $300,000 in cash on the day of sale, and the balance as directed by the Court, but any balance may be paid in claims or certificates of indebtedness established by the Court as leins prior to the first mortgage.

The sale is for the court charges and Receiver's debts, and is made necessary by the failure of the purchasers at the last sale to fulfill the conditions of the sale. The road will be sold free and clear of all incumbrances.

Galveston, Harrisburg & San Antonio.

Some trouble has arisen about the subscription of $75,000 town bonds to the branch to New Braunfels. One party claims that the aid voted was for the main line only, in case it should be located through New Braunfels, though the petition for the election did not specify the main line. Much objection is also made to the proposed location of the branch terminus, which is thought to be too far from the business portion of the town.

Sioux City & St. Paul.

The Land Department reports for November sales of 480.07 acres for $2,519. For the eleven months ending Nov. 30 the sales were 17,724.41 acres for $106,832.32, the average price being $6.02 per acre, and the receipts $3,585.15 in cash and $100,477.23 in bonds.

The operations of the road for November were as follows:

Freight earnings		$25,180 91
Passengers		7,084 70
Mail, express and miscellaneous		3,226 62
Total ($340 per mile)		$35,492 23
Working expenses (46.9 per cent.)		16,639 87
Net earnings ($127 per mile)		$18,852 36
Rents received		01 00
Equipment bond sinking fund		1,231 34
Balance from previous month		46,478 67
Total		$66,663 37
Elevator rents	$268 33	
Illinois Central track rent	1 605 00	
Special equipment fund	2,448 00	
State taxes	845 43	
Insurance	200 00	
		5,366 76
Balance at close of month		$61,296 61

As compared with November, 1875, there is a decrease of 24 per cent. in gross and of 8.6 per cent. in net earnings. For the eleven months ending Nov. 30 the road earned $333,705.89 gross and $106,278.22 net, being an increase of 20 per cent. in gross and 62.7 per cent. in net earnings.

Oley Valley.

Two preliminary surveys have been made for this projected road, one from Manatawny on the Colebrookdale Branch of the Reading road by the Manatawny Creek to Friedensburg, the other from Monocacy on the main line of the Reading by way of Amityville to Friedensburg, both being about 13 miles long. It is claimed that the road could be built at moderate cost and would secure a large traffic, as it would, by either route, pass through a thickly settled and prosperous country, and would reach some large deposits of iron ore.

Cumberland.

Two routes have been surveyed for this proposed road, one on the Maryland side of the Potomac from Cumberland to the mouth of Laurel Run, about 25 miles, the other running on the Virginia side of the river for two-thirds of the way. These surveys have been made in the interest of the Chesapeake & Ohio Canal; another line will shortly be surveyed in the interest of several of the coal-mining companies. The object in both cases is to secure a line from Cumberland to the coal mines independent of the Consolidation Coal Company.

Central Vermont.

The committee appointed to secure assent to the plan of reorganization proposed by this company gives notice that the holders of a considerable majority of the 8 per cent. or trust bonds have signified their assent to the proposed plan. That the directors of the Vermont & Canada Railroad Company have assented to the same. That a large number, but not a majority in interest, of the first and second mortgage bondholders of the Vermont Central Railroad Company have done the same. That the Central Vermont Railroad Company, in the exercise of the right reserved to it in the agreement as proposed, has waived the assent of a majority of the holders of these last-named bonds, and has thereby made the proposition binding upon it and its property, subject, of course, to the order of the Court of Chancery. A petition to the court will be filed at once for a sale of the property, with a view to carrying out the arrangement; and it has been agreed between the committee and the Central Vermont Railroad Company that the books should be kept open for all classes of securities until the action of the court upon said petition.

Gulf, Western Texas & Pacific.

Operations have been resumed on this road and trains are now running again from Indianola to Cuero. Local papers complain that the accommodations given are limited and the local rates very high, specifying among other things $1.25 per bushel for potatoes (70 miles) and six cents a pound for fresh fish, with other rates in proportion.

Chesapeake & Ohio Canal.

At the last regular meeting of the board the financial agents, Alexander Brown & Sons, of Baltimore, were directed to pay the coupon on the preferred construction bonds which became due July 1, 1864, and $50,985 were appropriated from the surplus earnings for that purpose.

Railroad Men and the Yellow-Fever Sufferers.

The final account of the committee to receive contributions for the yellow-fever sufferers is as follows:

Total receipts		$1,213 20
Paid for printing and postage	$43 00	
" Brunswick relief committee	150 00	
" families deceased conductors	50 00	
" Macon & Brunswick R. R. for families of deceased employes	145 50	
" Atlantic & Gulf R. R., for families of deceased employes	412 35	
" Central R. R., of Georgia, for families of deceased employes	412 35	
		1,213 20

The committee consisted of Messrs. L. P. Grant, Campbell Wallace, W. D. Chipley, L. L. McCleskey and H. H. Marmaduke.

Cincinnati, Avondale, Glendale & Hamilton.

The organization of this company has been completed and its certificate filed. The road, as heretofore noted, is to extend from Cincinnati, O., to Hamilton and is to be of 3-ft. gauge, for suburban traffic chiefly. The capital stock is fixed at $300,000. A survey of the route is to be made at once.

New Jersey Midland.

The report of the Receivers, G. A. Hobart and James W. McCulloh, for November is as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Passenger earnings	$18,088 36	$9,817 35	Inc.. $8,271 01	84.4
Freight	26,955 76	45,596 68	Dec.. 4,745 08	10.4
Milk	13,895 84			
Mail, express, etc.	7 040 70	3,641 98	Inc.. 3,398 72	93.4
Total	$65,980 66	$59,056 01	Inc.. $6,924 65	11.7
Drawbacks, freight charges, Montclair proportion of terminals, etc.	20,423 39			
Balance	$45,557 27			
Working and terminal expenses	33,156 89			
Net earnings	$12,400 38			

The earnings this year were $767 per mile. The Receivers' general account for the month is as follows:

Balance, Nov. 1		$599 25
Earnings		65,980 66
Loan account		6,019 37
Total		$72,599 46
Drawbacks, etc	$20,423 39	
Working and terminal expenses	33,156 89	
Construction account	3,091 55	
Equipment account	3,135 3	
Right of way account	805 85	
Loan account	11,810 00	
	72,423 05	
Balance Dec. 1		$176 32

There is no truth whatever in the reports which have been current that the repair shops were to be removed from Wortendyke to Paterson. No such plan has been considered, and even if the removal were desired it could not be made without an order of Court, which is not likely, under present circumstances, to be granted.

At the request of the Receivers, the Court of Chancery, in September last, appointed a master to examine their accounts. Due notice of the examination was given to parties interested, the bondholders were represented by counsel, and Mr. H. P. Dechert, Secretary of the bondholders' committee, was present through the whole examination. This examination was made with the utmost care and minuteness, all the books being gone through and their correctness tested, and all the vouchers on file, 6,047 in number, examined. The Master, in his report submitted to the Court, sums up his conclusions in the following words: "The Master reports that he finds the accounts to be correct; the books to be properly kept and posted; that there is a proper and sufficient voucher signed according to the form adopted by the Receivers for every expenditure; that all the money received by the Receivers has been charged to them; that the accounts have been kept with care and in a manner highly creditable to the ability as well as the integrity of the Receivers and of their employes."

Central, of New Jersey.

A circular from this company announces that it proposes to provide for a part of its accruing debt by the issue of $3,000,000 certificates of indebtedness, having ten years to run and bearing 7 per cent. interest. They are to be issued in sums of $100, $500 and $1,000 and will be secured by the deposit of $5,000,000 Lehigh & Wilkesbarre Coal Company bonds with the Guarantee Trust & Safe Deposit Company of Philadelphia. They are to be convertible at the option of the holders into consolidated mortgage bonds at par, and the company reserves the right to redeem them at any time at 105 and accrued interest. They are also to be receivable for 20 per cent. of all freight bills.

The circular states that no bonds issued under the new ten-year mortgage have been sold or used as collateral. They are not intended for sale and will be canceled as soon as the necessity for their use is past. The proposed $3,000,000 loan will put the company in an easy financial position. It states also that no sacrifices have been made to raise money and that four-fifths of the stock is still in the hands of the same parties who held it a year ago.

Subscriptions to the new loan will be received at the offices in New York and Philadelphia, and payment may be made in one sum or in installments.

Chicago & Lake Huron.

The work of tracklaying on the gap in the road between Flint, Mich., and Lansing was completed Dec. 19, near Lansing. There is yet some ballasting to do, and the line will probably not be opened until Jan. 1. The new track from Flint to Lansing was built by a separate company organized for that purpose and known as the Chicago & Northeastern, but it is controlled and the road will be worked by the Chicago & Lake Huron as part of its own line. The new track is 46 miles long and, with the older portions of the line, it completes a road 277 miles long from Port Huron, Mich., westward to Lansing, and thence west by south to Valparaiso, Ind.,

Under an agreement made some time ago the company claims the right to run its trains over the 44 miles of that road from Valparaiso to Chicago, making a line 321 miles long from Port Huron to Chicago. At Port Huron direct connection is made with the Grand Trunk and a large part of that company's Chicago business is expected to pass over this road.

St. Louis, Iron Mountain & Southern.

In the suit of the Rogers Locomotive Works against this company to recover damages for the failure of the company to take nine engines ordered, a decision has been reached. The claim was for the difference between the contract price and that at which the engines were afterwards sold, and the Court gave the Rogers Works a judgment for the full amount of the claim, with interest, amounting in all to $53,000.

Toledo, Wabash & Western.

The New York Supreme Court has refused to grant the *mandamus* asked for to compel the issue of consolidated bonds to the holders of the equipment bonds of this company. The Court held that by the terms of the consolidation it was left to the directors to decide how the debts of the older corporations should be assumed, and under the circumstances a *mandamus* was not the proper remedy, but plaintiffs should seek to recover by a suit in equity.

The new company, the Wabash Railway Company, has filed the necessary articles of incorporation in Illinois.

North Pacific Coast.

This road is now completed to Moscow, Cal., on Russian River, 79 miles from the southern terminus at Saucelito on San Francisco Bay, and 30 miles beyond last year's terminus at Tomales. The southern portion of the road, completed a year ago, runs through a country which contains some timber, but whose chief traffic is in grain, vegetables and dairy products, Marin and Sonoma counties being the great dairy region of California and largely supplying San Francisco with milk and butter. At Freestone the extension just completed reaches the southern edge of the great redwood forest, which covers a large part of Sonoma, Humboldt and Mendocino counties, and continues through it to Moscow, where large saw-mills have already been established. Moscow is the centre of an extensive tract owned by the Russian River Land and Lumber Company, the stockholders of which are also the chief owners of the railroad, and is intended to be a large lumber manufacturing town.

The company now owns a main line from Saucelito to Moscow, 79 miles, with a branch from San Rafael Junction to San Quentin, 5¼ miles, making 84¼ miles in all; it runs two steam ferries to San Francisco, one about six miles long from Saucelito, and one about 11¼ miles long, from San Quentin. The equipment from the road is 11 locomotives, 13 passenger and 300 freight cars; 200 flat cars are being built in the Saucelito shops, and some locomotives and passenger cars have been contracted for. The road is of 3 ft. gauge, has some heavy grades and many curves, being built through a rough and hilly country. It has been built by individual stock subscriptions, except a subsidy of $150,000 from Marin County.

Lone Rock, Dodgeville & Freeport.

The towns of Blanchard and Argyle in Lafayette County, Wis., have voted a 5 per cent. tax in aid of this projected road. The right of way has been given for 12 miles south of Blanchardville and a good many individual subscriptions to the stock secured.

Southern Pacific.

The engineers are making surveys in the vicinity of Fort Yuma and examining the Colorado River in that vicinity in order to determine the location of the bridge there.

Connecticut Western.

At the adjourned meeting of the bondholders in Hartford, Conn., Dec. 20, the committee appointed at the previous meeting reported that the debt of the company is: bonds, $3,200,000; overdue coupons, $210,000; taxes, $155,000. The committee recommended that the company's proposal to fund coupons be rejected, and that either foreclosure proceedings be instituted, or that bondholders exchange their bonds for 7 per cent. preferred stock. After a long debate the meeting voted in favor of a plan providing for the surrender of the bonds to be held in trust and the issue in place thereof of 7 per cent. preferred stock, as proposed, the common stockholders to have the right to redeem such stock at any time at par and accrued interest. The preferred stockholders will have control of the management. The committee was instructed to communicate with all the bondholders. It was voted also that the directors should issue no more bonds.

Sonoma.

This road is now completed from Norfolk, on Sonoma Creek, 3¼ miles towards Sonoma, Cal., and two miles more are nearly ready for use. Surveys have been made for an extension from Norfolk to Sears' Point, eight miles, and from Sonoma to Santa Rosa, 23 miles, with a branch of three miles to Buena Vista. The road is built on the prismoidal or one-rail principle, having a triangular rail of wood 27 inches base and 15 inches high, shod with iron on top. The engines and cars are carried on central wheels which run on the iron shoe on the top of the triangular rail, and there are balance wheels running near the base of the prism to prevent oscillation of the cars. At the lowest point of the car, wheels are placed which run on special rails laid at road crossings where the prismoidal rail could not be laid. The cost of the road is said to be about $4,500 per mile.

Denver & Rio Grande.

The Auditor's report for October is as follows, for the main line, 120 miles:

Freight earnings	$22,071 81
Passengers	13,891 51
Miscellaneous	147 38
Total ($301 per mile)	$36,110 70
Expenses (55.94 per cent.)	20,201 06
Net earnings ($133 per mile)	$15,909 64

Of the gross earnings $1,153 were from mails and other Government business. Whatever sums referees may award as this company's proportion of competitive business, under the agreement with the Kansas Pacific, are to be added to the net earnings. As compared with October, 1875, there is an increase of 24.6 per cent. in gross, and of 49.3 per cent. in net earnings.

New Orleans, Mobile & Texas.

New Orleans papers report that work is to be begun on the extension of the Western Division from Bayou Goula to the Sabine River, as soon as the necessary arrangements can be made.

ANNUAL REPORTS.

Windsor & Annapolis.

This company works a line 116 miles long, from Windsor Junction, Nova Scotia, west by south to Annapolis, and it runs its trains over the Intercolonial track from Windsor Junction to Halifax, 13 miles. Of the line worked 84 miles, from Windsor to Annapolis, is owned by the company, and 32 miles, from Windsor Junction to Windsor, was built as a branch of the Nova Scotia (now part of the Intercolonial Railway), and is leased from the Dominion of Canada. The present report covers the year ending June 30, 1876.

The equipment consists of 10 engines, 10 tenders and 2 snow-plows; 6 first-class, 3 second-class and 2 composite passenger, 2 post-office and 3 express and baggage cars; 50 box, 20 coal and 72 platform cars.

The capital account at the close of the year was as follows:

Capital stock	£301,500
B debenture stock	292,800
Mortgage bonds	900
Government subsidy	223,951
Total	£819,151

The stock and bonds are at the rate of $37,724, currency, per mile. During the year, in pursuance of an agreement previously made, the company's bonds were converted into B debenture stock, except £900, which are still outstanding. The company holds unissued £198,500 ordinary stock, £75,000 A debenture stock and £57,200 B debenture stock. Charges to capital account for the year were £10,330 for improvements and £11,492 deficiency for the year.

The train mileage for the year was as follows:

	1875-76.	1874-75.	Decrease.	P. c.
Passenger trains	61,071	62,914	1,843	2.9
Mixed trains	109,396	117,012	7,616	6.5
Service trains	11,479	17,803	6,324	35.5
Total	181,946	197,729	15,783	8.0

The earnings for the year were as follows:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Passengers	£20,612	£23,043	Dec.. £2,431	10.6
Merchandise	19,506	20,526	Dec.. 1,020	5.0
Miscellaneous	320	203	Inc.. 117	58.5
Total	£40,438	£43,772	Dec.. £3,334	7.6
Working expenses	33,373	37,107	Dec.. 3,734	10.1
Net earnings	£7,065	£6,665	Inc.. £400	6.0
Gross earn. per mile	349	377	Dec.. 28	7.6
Net " " "	61	57	Inc.. 4	6.0
Per cent. of expenses	82.53	84.77	Dec.. 2 24	2.6

The falling off in earnings resulted chiefly from the general depression of business. The trade in grain and flour from the Upper Provinces, most of which has heretofore gone by water, is increasing since the opening of the Intercolonial for through business. The Western Counties road, now under construction, is expected to bring much business to the road, and it is thought that the Nova Scotia, Nictaux & Atlantic Central now under contract, will be a valuable feeder, as it opens up a district abounding in lumber and iron ore. Reduced to American currency the earnings this year were $1,858 gross and $325 net per mile.

During the year 36,000 new ties and 190 tons of rails were laid and the road and equipment fully maintained. The new line at Hancock's Ravine and the filling of Blue Beach bridge were completed; work has been begun on the new line at Earl's Creek, the Halfway River dyke and the filling of Mud Creek bridge. The directors believe that the expenditure of a moderate amount would make an excellent road and decrease the cost of working. Extensive improvements have been made on the leased line.

Connecticut Valley.

This company owns a line from Hartford, Conn., southeast down the west bank of the Connecticut River to Saybrook Point, 46.5 miles. For six months of the last fiscal year, from January to June, the company worked under lease an extension 30 miles long, from Hartford to Springfield, made up of the Connecticut Central, 21 miles, the Springfield & New London, 7 miles, a mile of the Hartford, Providence & Fishkill out of Hartford and a mile of the Springfield, Athol & Northeastern out of Springfield. The report, however, relates to the Valley road alone. The report covers the year ending Sept. 30, 1876, for nine months of which the road was worked by the company, and for the remaining three by the State Treasurer of Connecticut as Receiver.

The outstanding securities are as follows:

Stock ($22,840 per mile)	$1,059,800
Bonds ($48,492 per mile)	2,250,000
Total ($71,332 per mile)	$3,309,800

Of the bonds $1,250,000 are second mortgage bonds issued in settlement of floating debt, and no interest has ever been paid on them. There is also a large floating debt, the amount of which is not stated. There is also a considerable amount due the State for taxes, payment of which is suspended.

The earnings for the year were as follows:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Passengers	$123,111 99	$150,526 89	Dec.. $27,414 90	18.2
Freight	128,845 27	98,669 34	Inc.. 30,175 93	30.6
Other sources	16,884 62	21,862 32	Dec.. 4,977 70	22.7
Total	$268,841 88	$271,058 55	Dec.. $2,216 67	0.8
Expenses	255,149 25	134,748 45	Inc.. 122,400 80	92.2
Net earnings	$13,692 63	$138,310 10	Dec.. $124,617 47	90.1
Gross earnings per mile	5,781 04	5,829 21	Dec.. 48 17	0.8
Net earn. per mile	294 47	2,974 41	Dec.. 2,679 94	90.1
Per cent. of expen.	94.91	48.97	Inc.. 45.94	94.0

The Springfield line seems to have brought only an increase of expenses. The earnings were divided between the two managements as follows:

	Earnings.	Expenses.	Net earn.	Per ct. of exp.
Company, nine months	$203,127 49	$218,935 48	$15,807 99*	107.78
Trustee, three months	65,714 39	36,213 77	29,500 62	55 12
Total, one year	$268,841 88	$255,149 25	$13,692 63	94.91

* Deficit.

The President's report says that in April last a committee was appointed to negotiate for the extension of the floating debt, as the second-mortgage bondholders had offered to forego the payment of interest for three years, if the floating debt creditors would agree to postpone their claims or grant an extension and accept notes at 18, 24 and 36 months. This arrangement could not be made, and it was voted in June to surrender the road to the State Treasurer of Connecticut as Trustee for the second-mortgage bondholders, as attachments and suits threatened to put a stop to the running of trains. The surrender was made June 30, and since that time the road has been managed by Samuel Babcock and E. R. Wiggin, as agents for the Trustee. Another condition made by the bondholders was that the road should be worked for 60 per cent. of the gross earnings, which the management was unable to do. Nothing has been done towards a reorganization of the company as yet.

The report speaks at considerable length of the complications arising from the Connecticut Central and Springfield & New London leases, which we have heretofore referred to. The present position of affairs is very unsatisfactory; the Springfield and New London is leased by this company and sub-leased to the Connecticut Central, but that company it is claimed, has not fulfilled its agreements. There has been constant trouble, and it is thought that the lease will have to be set aside.

Fracture of Railway Tires.

The following is a summary of a paper by Mr. W. W. Beaumont, Assoc. Inst. C. E., read at a meeting of the Institution of Civil Engineers, Nov. 21, 1876, as published in *Engineering*:

It was stated that between the years 1847 and 1874 eighty accidents from broken tires, attended by serious results, had been reported upon by the officers of the Board of Trade. The total number of tires fractured was not known, as previous to 1872 the railway companies made no return of such accidents; but, since 1847, tire fractures had resulted in the loss of 74 lives and 236 cases of serious personal injury. So far as the author was aware, no satisfactory explanation had been given of the forces productive of fracture of tires of good material and workmanship; and it was the object of his paper to suggest a cause for their origin. Some of the theories advanced to account for tire fracture were treated of; such as the strain due to shrinking tires on to wheel bodies, the reduction of the sectional area by rivet or bolt holes, and the alleged reduction of the strength of the tire by low temperatures in winter. These causes were considered to be inadequate to account for:

1st. The fracture of a good tire; 2d. The fracture of tires in several places simultaneously; 3d. The fracture of tires through the solid rather than through bolt or rivet holes; 4th. Breakages being few in number for a long period, followed by a shorter period of frequent fracture; and 5th. Tires being generally of considerable age, or running several thousand miles before flying to pieces.

For an explanation of these facts the author appealed to internal differential molecular strains, generated in the material of tires, by extension and compression from their surface inwards, consequent upon their rolling at high velocities under heavy loads, along the hard, smooth, and somewhat rigid permanent way. If a piece of flat, stout plate metal was subjected, when cold, to long continued light hammering, or rolling, on one of its surfaces, that surface would become compressed and elongated. The effect of thus altering the relative dimensions of the two surfaces of the originally flat plate would be to make it assume the form of an umbo, with the convexity towards the rolled or hammered surface. In illustration of this, reference was made to the straightening of coping plates, or other plate castings, which had become bent in cooling, by lightly hammering the concave side and thus elongating that side. Another example was afforded in the curvature produced in tram plates, for instance those on Westminster Bridge, by the extension and compression of the surface exposed to the rolling under the loaded wheels of vehicles. Similarly, film after film from the surface inwards of the material of a railway tire was compressed, until the thickness so molecularly altered induced internal differential strains sufficient to rupture the tire, or so nearly to affect it, that an unusually heavy impulse, or other extraneous force, was alone necessary for such a result. As these strains approached equality throughout the tire, the length, and therefore the number of pieces into which the tire would be broken, would be determined by the limit of stability and the coefficient of elasticity of the material. Absolute simultaneity of multiple fracture was not a necessary condition of such a result, as the precedence of one fracture would liberate the tire, so that the internal forces would be free to initiate fracture in as many places as might be necessary to expend the excess of the forces tending to rupture over those of resistance to it. Of the reported fractures of tires affixed by rivets or screws, nearly one-third were fractured through the full section, and not at a bolt or rivet hole; thus indicating that those tires were either strongest at the reduced section, or that the internal forces tending to produce fracture were greater between than at the rivet or bolt holes. In tires of good material and workmanship fracture would be expected to take place rather between than through such holes; for at these the continuity of the material was broken, so that the compression, produced in the outer portions of the tire by the impeded elongation of the material, was dissipated by an upward flow of the particles round such holes. This upward flow tended to produce a crater-like ridge, which was quickly worn off, so that the tire at these points was relieved of strain, the material that would have exerted it being carried away. Elastic wheels could only be considered as a palliative, for the tire had still to support a load, so that its surface would be subject to compression, although the mischief would not proceed so rapidly as with a nearly rigid wheel. The inertia of impact strain upon a rigid wheel would have to be overcome by the tire before it was relieved by the springs of the vehicle, whereas a good elastic wheel possessed in some degree the character of a spring, and in so far was without such inertia. However good the material and workmanship of a railway tire, and in whatever manner affixed, it must gradually become unsafe, from other reasons than simple loss of thickness, for whether it was of steel or of iron it was amenable to the production and accumulation of the molecular strains described. The great durability of American chilled wheels was probably owing to the extreme hardness of their running surfaces, and their consequent resistance to surface compression. Although the ultimate strength of a tire was probably not reduced by the bolt or rivet holes, the preferable method of fastening was unquestionably by continuous clips and grooves on both sides of the tire, so as to prevent the portions of a fractured tire from leaving the wheel. It was to this latter cause, rather than to simple fracture, that many lamentable accidents were to be ascribed.

Master Mechanics' Association—Slide Valves and Valve Gearing.

The Committee appointed by the American Railway Master Mechanics' Association to report on "Slide Valves and Valve Gearing" respectfully present the following series of questions, and request an early reply thereto. For convenience, we will confine our inquiries to engines with 16×24 cylinders.

DIMENSIONS OF STEAM-PORTS.

1st. What would you recommend as the proper dimensions of induction ports?

2d. What the proper dimensions of exhaust ports?

3d. Would you recommend contracting the induction ports after leaving the valve face; if so, how much?

VALVES.

1. How much outside lap would you recommend for passenger engines?

2d. How much outside lap for freight engines?

3d. How much inside lap would you recommend for passenger engines?

4th. How much inside lap for freight engines?

5th. How much travel of valve for passenger engines?

6th. How much travel of valve for freight engines?

7th. How much lead when in full gear for passenger engines?

8th. How much lead when in full gear for freight engines?

9th. Have you had any experience with balanced valves? If so, please furnish name and description of valve, and also what the results have been from their use in the matter of economy?

VALVE GEARING.

1st. Have you found in your experience any device for operating the valves more satisfactory than the shifting link?

2d. What do you consider the proper distance between the centre of driving axle and the centre of the rocker?

3. How do you determine the radius of the shifting link?

Have you had any experience with indicator in taking diagrams from cylinders of locomotives? If so, will you please furnish copies of diagrams, with data to determine their value.

Please reply before March 1, 1877, addressing the Chairman of the Committee,

JAMES N. LAUDER, Master Mechanic Northern (N. H.) Railroad, Concord, N. H.

JAS. N. LAUDER, Northern (N. H. R. R.
WM. S. HUDSON, Roger Loco. Works.
F. A. WAITE, B. & M. R. R.
Committee.